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HEATING AND VENTILATING

AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION

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Welding of Sheet Metal . . page 76

Ventilation and Industrial Health . . . . page 67

Selection of Hot Water Pipe . . . page 58

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THIS MONTH'S COVER

Exposure to sun is an important factor in heating. See results of tests described in "The Solar House" by F. W. Hutchinson, page 53. Cover photo by Leppert from Frederic Lewis.

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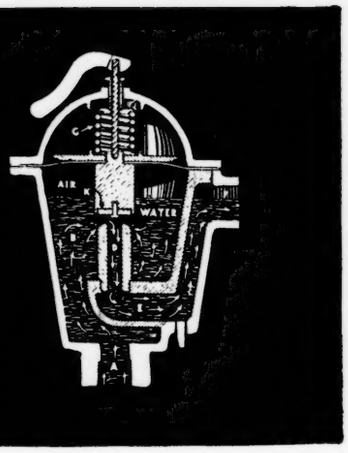

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Washington News

LORING F. OVERMAN

Housing Program.
Legislators Act.
Permanent and Temporary.
Mass Production Houses?
More Controls.

NEXT to strikes and price control, the hottest subject in Washington is the one closest to the heating, ventilating and air-conditioning industries—housing.

Although these industries may normally consider themselves more interested in construction than in housing as such, for the present the reverse is true. The reason is that the housing program may well become the construction program under current conditions. As forecast in this column in January when Priorities Regulation 33 was enacted to channel scarce building materials into veterans' housing projects, pressure from returning servicemen has become so severe that the Administration has labeled as a political "must" a program to satisfy this 10,000,000-strong segment of service voters and their new wives, husbands and in-laws.

Administration Program

To carry such a program into effect, the President and his administrative assistants are urging that Congress enact legislation promptly. To speed up administrative action, Wilson W. Wyatt, former Housing Expeditor, was named National Housing Administrator, to replace John B. Blandford. In the name of the Administration, Mr. Wyatt is asking for enactment of the following program:

1. Stabilization of housing prices to the extent of fixing price ceilings for old and new houses, flexible enough to provide for different sectional conditions.
2. Rent ceilings.
3. A system of priorities to control the use of housing materials.
4. A preference for veterans in acquiring new houses.
5. A $600,000,000 authorization to be used as subsidies in the building of houses.
6. Authorization of $250,000,000 to finance Government participation in the building of houses.
7. Authorization for a system of rapid tax amortization of any new private plants built to produce materials or finished houses.

Discouraging to proponents of the program (and regarded with some satisfaction by opponents of some or all of the methods proposed) is the fact that there is no single bill pending before any one Congressional committee that would meet the recommendations of President Truman, as voiced through Mr. Wyatt. Consequently, a piece-meal approach is in prospect, with several bills being considered by several different committees, with a piece-meal solution as the probable result.

Applicable Legislation

The first five recommendations proposed by Mr. Wyatt are embodied in the Patman Bill (H.R. 4761), and the Lanham Bill (H.R. 5455) would authorize expenditure of $250,000,000 to provide an additional 100,000 temporary housing units for distressed families of servicemen and for veterans and their families. This Bill, a companion to S. 1821, by Senator Mead, (before the Senate Education and Labor Committee) was referred to the House Public Buildings and Grounds Committee for consideration.

Point 7 of the Wyatt proposal, referring to tax amortization, was referred to the House Ways and Means Committee for study—not in Bill form and with no immediate action contemplated.

In addition to the foregoing Bills and proposals designed to meet emergency conditions, the Administration has also gone on record in support of the Wagner-Ellender-Taft Permanent Housing Bill, of which more later.

The Patman Bill

The Patman Bill would establish an office of Housing Stabilization with authorization to make surveys and investigations; establish maximum sale prices for existing housing and set maximum sale prices for housing constructed after passage of this bill in accordance with certain standards. The Director would be authorized to regulate or channel materials when a shortage was apparent, give preference to veterans, and when no alternative method was available, could subsidize construction of new low-cost housing. The Director would also be authorized to prevent evasion by means of coercive or manipulative practices, and penalties would be set up for violations.

Provisions for price ceilings on existing houses were eliminated from the Bill during committee hearings, but it was anticipated they would be re-introduced when the subject comes before the House for consideration.

Supporters of the Bill contend that with shortages of labor and materials, Government must control all construction, directing scarce supplies into the most needed types of building. They also contend that a program of subsidies is needed to keep housing prices down.

Opponents, while agreeing upon the need for additional housing, believe that Government participation will not solve the problem. They contend that the problem is not one of control but of production; that Government controls are responsible for present shortages; that price control has hampered production instead of helping it, and that no producer has asked for subsidies.

If passed by the House (probably with numerous softening amendments), early action in the Senate is not too likely, for the bill would be referred to the Senate Banking Currency Committee, which has a

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number of other "musts" on its calendar. Included is the British loan question, extension of O.P.A., and the Senate permanent housing bill, unreported after two months of on and off hearings.

Permanent Housing Bill

Earliest of several housing bills to receive Administration approval was a permanent housing bill (S.1592), introduced in the Senate on November 15 by Senators Wagner, Ellender and Taft. As introduced—but later subjected to several amendments following months of hearings before the Banking and Currency Committee—the bill would provide for establishment of a permanent Housing Agency and authorize a five-year $500,000,000 slum clearance program. Provisions included:

1. Authorizing expenditures of $12,500,000 for each of five years for housing research.
2. Authorizing $50,000,000 for each of five years to encourage local planning, setting up a home-loan plan providing for 32-year amortization.
3. Authorizing $500,000,000 of loans to localities for slum clearance projects, providing for construction of 500,000 low rent public housing units over a four year period, providing for an annual inventory of housing, and authorizing the sale of war housing to communities.

Because the bill sets up another permanent Government agency and forecasts the continuing presence of Government in the construction field, the Wagner-Ellender-Taft bill runs smack into the opposition of private building organizations and their national trade associations. Proponents of the bill contend that the Federal Government can best handle the problem of slum clearance because of its power to condemn and acquire property. Private enterprise contends it has demonstrated its ability to do the job, make a profit and still build cheaper than the Federal Government. Passage of the bill in its present form does not seem imminent, despite Administration enthusiasm for its provisions.

Government Housing

Favorable action is considered likely on the Lanham Bill and the companion Mead Senate bill to authorize 100,000 temporary units for servicemen and their families. Although opponents contend this is just another step toward permanent Government participation in the housing industry, emergency considerations will probably outweigh the seemingly logical opposing question—"how can the Government build houses more rapidly than private industry?"

Mass Production Proposed

As if in answer to this query, the Wyatt outline proposes something that the building industry itself has never been able to make much progress with—massed-produced homes, with emphasis on prefabrication. For 1946 Wyatt hopes to see erected 250,000 prefabricated units, 700,000 conventional homes and 250,000 temporary dwellings. For 1947 the goal is 600,000 prefabs and 900,000 conventionals. In announcing his plan, Wyatt points out that Great Britain and other countries are solving their housing problems via the mass-production method.

In stressing the necessity of leaning heavily upon prefabricators, Wyatt points out that the conventional building industry, in its best year of 1925, turned out only 937,000 units. At the end of 1945 it had only 100,000 units under way, and as its own estimate for 1946 had set the top limit at little more than 400,000.

Analysts of the housing problem contend that the conventional building industry is only a step beyond the handicraft stage and that it has not kept pace with other industries, like automobiles or appliances, in giving the buyer as much for his dollar. In mass production fields, they contend, prices normally drop as production increases, while in the building industry, prices customarily rise when business volume is good. As reasons for this condition, which does appear to reverse the scheme upon which the American standard of living is founded, they point out:

1. More than 2000,000 builders or sub-contractors operate on an average net volume of only $21,000.
2. The 30,000-odd parts that go into the average home involve a distribution system drawing upon 88 separate industries.
3. Restrictive practices in the conventional building industry are ancient, notorious and without sign of improvement.

A New Day?

Although those who comprise the heating, ventilating and air-conditioning industries may feel that their futures are inalterably linked with the conventional building industry, it "could be" that now is the time to see that the prefabricators, too, know all there is to know about the products of this field. With such names as Henry Kaiser, Andrew Higgins, Reynolds Metals and U. S. Steel (via Foster Gunnison) appearing among the growing list of top-flight producers of prefabricated housing, it would seem that the subject has become too important to be flicked away.

Although attention of the prefabricators is focussed for the present upon small units, it is not impossible that some of the lessons learned may soon be reflected in marked changes in industrial and commercial fields.

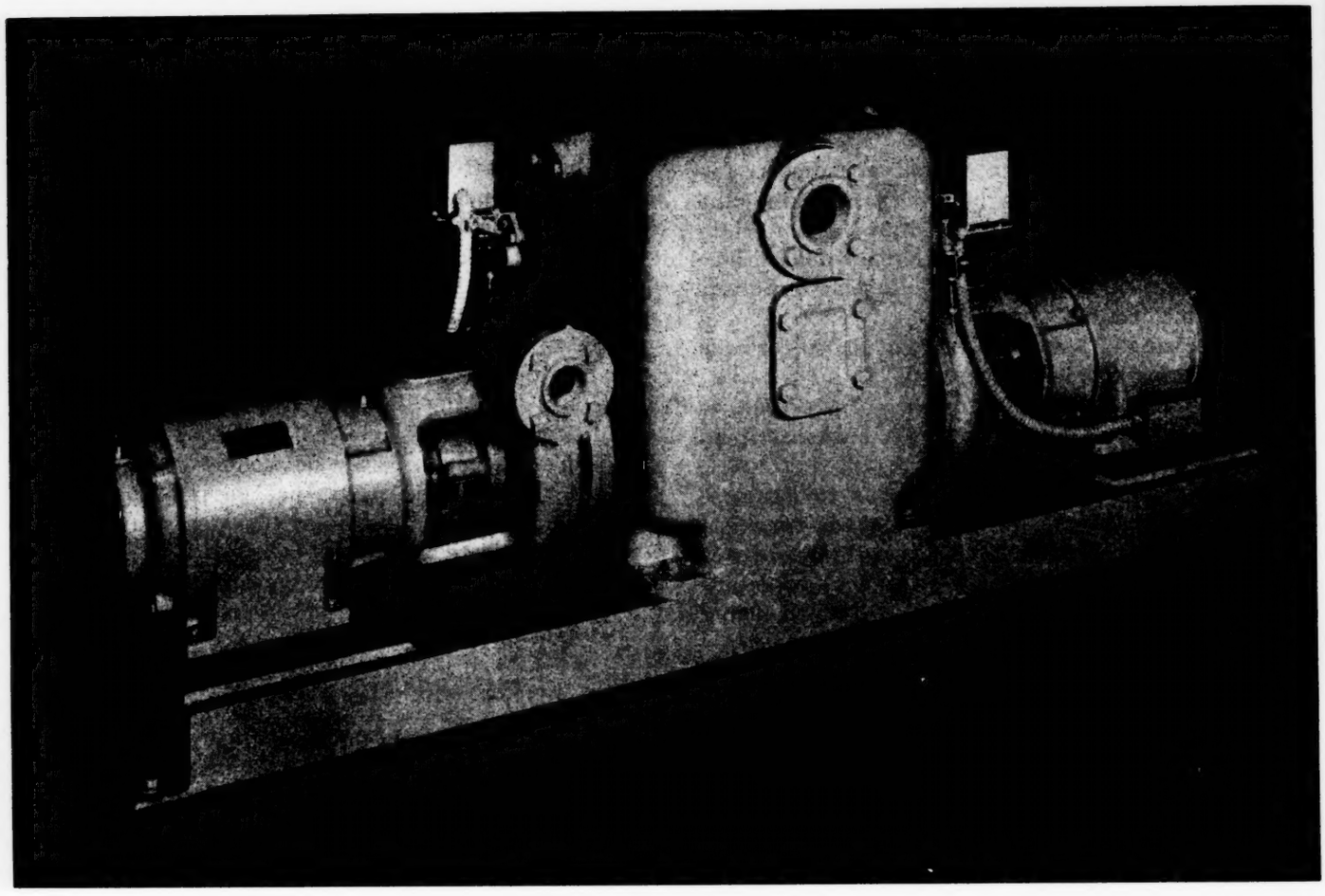
Three Uncertainties

To date, progress of the prefabricating idea has been blocked by three obstacles: lack of public acceptance, building restrictions, and labor's attitude. With half a million or more families scheduled to become involuntary guinea pigs for what promises to be the first mass trial of prefabricated housing, it just "could be" that they would turn out to be 500,000 enthusiastic boosters for the idea. Should this prove to be the case, the future of the industry is assured.

As for building codes, Wyatt has announced that at a recent conference with mayors of major cities, he was assured that codes would be waived for satisfactory houses "in practically all localities." With this assurance as an entering wedge, it is quite likely that the prefabricated house idea may become the instrument that will speed the much-sought liberalization

(Continued on page 96)

MAXIMUM EFFICIENCY FOR STEAM HEATING SYSTEMS ON HEATING, DRYING AND PROCESS WORK.



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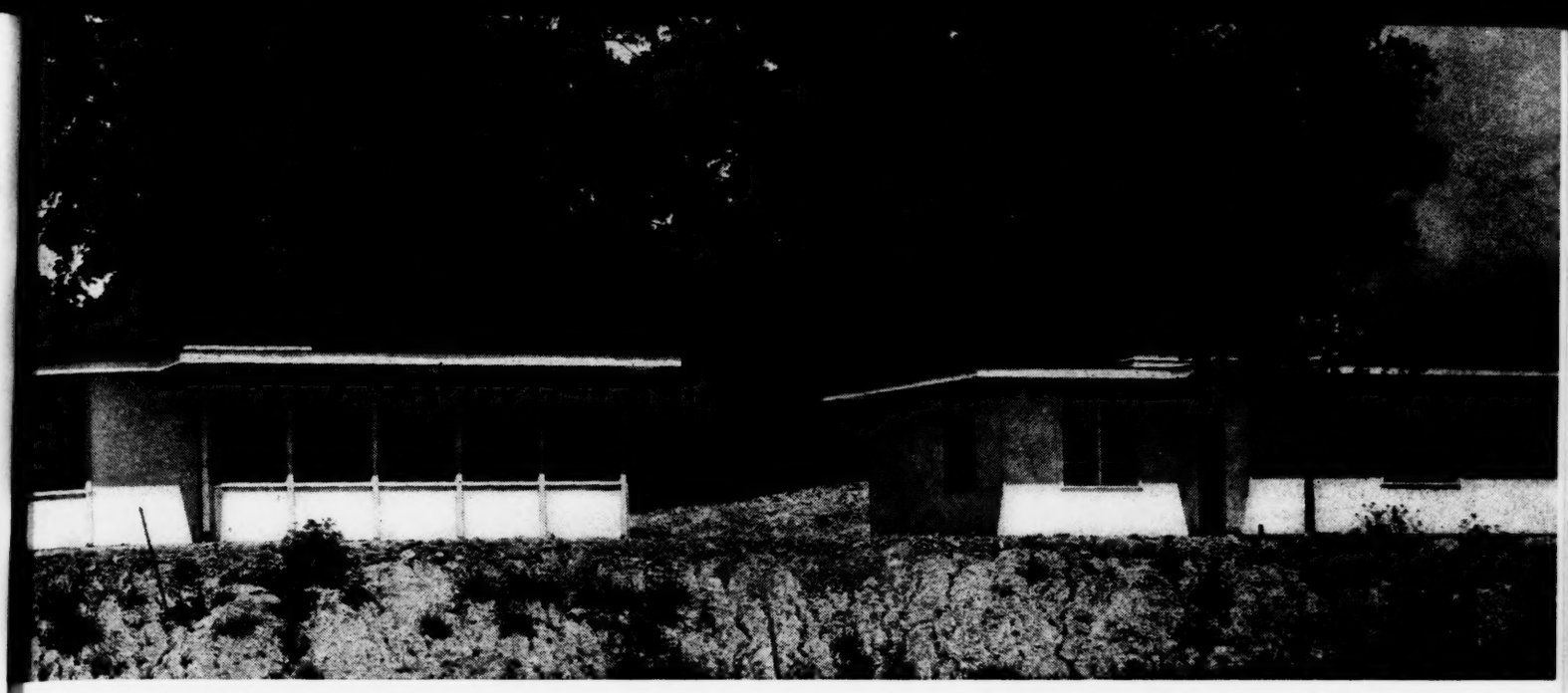


Fig. 1. Houses identical, with exception of glass area, photographed in July for Purdue experiments.

The Solar House: A Research Progress Report

How much heat is gained from the sun; and how can "solar" construction best take advantage of the sun's energy? Partial answers to these questions are contained in this progress report on Purdue's solar house experiments. Mr. Hutchinson's article is a technical paper prepared in cooperation with the Housing Research Division of the Purdue Research Foundation: G. Stanley Meikle, Research Director of the Foundation; Carl F. Boester, Foundation Housing Executive.

F. W. HUTCHINSON
Professor of Mechanical Engineering, Purdue University, Lafayette, Indiana

WITHIN the past year, under a grant provided by the Libby-Owens-Ford Glass Co., staff members of the Purdue University School of Mechanical Engineering have been conducting an impartial engineering study* of solar housing. Two full-scale (1830 sq ft floor area) experimental houses have been erected on the campus; thermally and architecturally these houses are identical except that the "orthodox" house has glass in 12% of its wall area while the "solar" house has 22½% of wall area in glass. The north and west walls of both houses have approximately the same window area, but in the east wall the solar house has 80% more glass than the orthodox and in the south wall the solar house has 112 sq ft of glass (51% of wall area) in contrast with the 41 sq ft of glass (18½% of wall area) in the orthodox house. Exactly the same kind of glass (two layers with air space) is used in all windows of both houses.

Fig. 1 and 2 are photographs of the houses taken in July 1945 and in January 1946, respectively; the first photograph shows how the roof overhang shades the windows during the summer months and prevents the entry of direct sunlight, whereas the second figure illustrates the manner in which winter sunlight gains entrance to the structure. Fig. 3 and 4 are interior photographs of the two houses taken in January 1946 within 15 minutes of the time at which the photograph of Fig. 2 was obtained. Fig. 3 shows the extensive irradiation of the floor of the solar house which occurs at mid-day in winter while Fig. 4 clearly illustrates the greatly reduced irradiation experienced at the floor of the orthodox house.

Experimental Procedure

In order to reduce to its simplest possible terms the problem of determining comparative heating costs for the two houses the decision was made to run a continuous two month test without any form of heating in either house. By keeping continuous records of the outside air temperature, wind velocity, wind direction, hours of sunshine, and the inside air temperatures in each of the two houses, data should be available from which to calculate the number of degree-hours theoretically required (based on the actual outside air temperature) and the number of degree hours actually required for each house based on the respective inside air temperatures. Comparison of these three values

*The Solar House: A Full-Scale Experimental Study, F. W. Hutchinson, HEATING AND VENTILATING, September, 1945.

Table 1—Weekly Averages for the 9 Week Test Period

Week of	Temperature of Air			% Reduction in Actual Degree-Hours Required; Based on *Theoretical Number* from Outside Air Temperature.		Hours of Sun	% Sun	% Reduction in Degree-Hours of Solar over Orthodox.
	Outside	Inside Solar	Inside Orthodox	(Solar)	(Orthodox)			
12/1/45-12/8/45	34.9	40.7	39.1	19.2	13.9	13.0	7.75	6.20
12/8/45-12/15/45	23.2	34.9	33.0	28.0	23.3	18.0	10.70	5.95
12/15/45-12/22/45	8.0	27.6	24.2	34.3	28.3	26.0	15.50	8.35
12/22/45-12/29/45	23.3	29.1	29.0	13.9	13.6	10.0	5.95	.28
12/29/45-1/5/46	29.0	33.9	32.8	13.55	10.5	8.3	4.95	3.42
1/5/46-1/12/46	39.8	41.3	40.8	5.97	3.97	7.0	4.17	1.22
1/12/46-1/19/46	27.0	45.9	36.4	49.8	24.6	47.0	28.00	33.00
1/19/46-1/26/46	21.7	34.8	31.2	30.3	21.8	22.5	13.40	10.65
1/26/46-2/2/46	24.6	36.0	32.0	28.2	18.2	33.5	19.95	12.10
Overall Weekly Average	25.7	36.0	33.2	24.8	17.6	20.6	12.26	9.02

would then permit determination of the percent saving or loss (in degree-hours) of the solar house as compared with both the theoretical requirements and also the actual requirements of the orthodox house. Note, however, that the proposed comparison is on a degree-hour basis rather than an energy input basis, hence it will not permit direct comparison of heating costs; this latter comparison is expected to result from the second part of the experimental work, using controlled electric heating in both houses, which will be conducted over the two month period from mid-February until mid-April.

The period used for the unheated tests consisted of the nine consecutive weeks from December 1, 1945, to February 2, 1946. Throughout this interval all data were recorded continuously, and from the charts arithmetical averages of the 168 hourly readings were obtained, thereby providing the weekly average temperatures which are shown in Table 1. Thus for any given week the apparent degree hours are equal to 168 (hours per week) multiplied by the difference between 65F and the average outside temperature. Similarly, the actual degree-hour heating requirements of the two houses are, respectively, 168 multiplied by the difference between 65F and the average inside air temperatures. Fig. 5 shows a representative 24-hour plotting of the basic data which were used in compiling Table 1.

Discussion of Results

Table 2 gives a representative tabulation of data for the 1-day period covered by the chart section shown in Fig. 5. At 1 a.m. on December 17, for example, the solar, orthodox, and outside air temperatures were, respectively, 18, 21 and 0F; hence the indicated degree hours for the hour ending at 1 a.m. can be taken as 47 for the solar house, 44 for the orthodox house and 65 based on the actual outside air temperature; these values are shown in the first row of Table 2 with subsequent values, similarly determined, for each of the 23 succeeding hours of the day. As indicated at the bottom of the table, the actual degree hours for December 17 are 1,416 against 966 degree hours which were needed for the orthodox house and 760 for the solar house.

The results for this one day are of particular interest since they indicate that the orthodox house receives a substantial amount of radiant energy and its air temperature is continuously and substantially

Fig. 2. Same houses as in Fig. 1, photographed in January at 12:30 p. m. Note sun's access to windows.

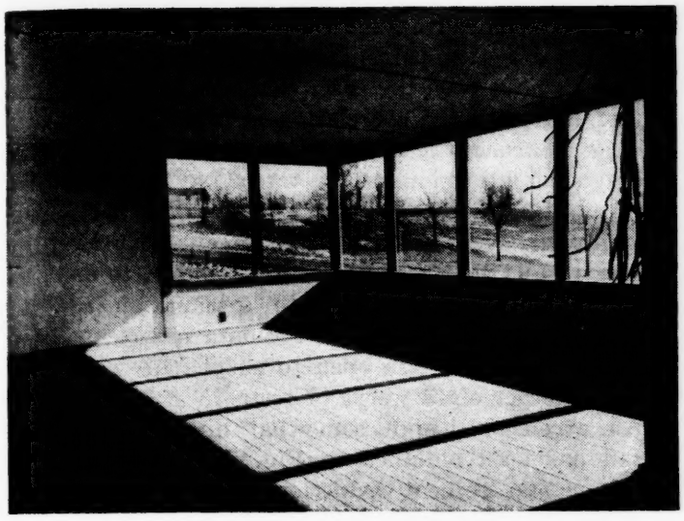


Fig. 3. Photo taken within 15 min. of Fig. 2 shows extensive irradiation on floor inside the solar house.

Fig. 4. Showing limited irradiation on floor of orthodox house. This photo also taken within 15 min. of Fig. 2.

higher than the outside air temperature. Thus the actual heating requirements of the orthodox house are only 966/1416 = 68% of the theoretical value; therefore solar energy contributes a 32% "dividend" even though no special arrangements were made to utilize such energy with maximum effectiveness.

For December 17 the solar house required 760 degree hours or 760/1416 = 53½% of the theoretical value; thus solar energy reduced by 46½% the heating requirements on this particular day for this particular house. To assist in visualizing the significance of this result it should be noted that the average outside temperature for the 24 hour period was 6F and there were 6½ hours of continuous sunshine. If the equivalent overall coefficient of heat transfer (weighted average based on the areas having different conductance or exposure) were the same for the solar and orthodox houses it would then be possible to state that the solar house afforded a 14¼% lower heat requirement (based on actual degree hours) than the orthodox house, or — more explicitly — that the solar house would require (966 — 760)/966 = 21½% less heat than the orthodox house. Actually, however, the solar house has a higher equivalent overall coefficient than the orthodox house hence a direct comparison of heating requirements is not possible.

The above discussion brings out the very important fact that the solar gain realized in a house of so-called solar construction should not be entirely attributed to the construction since a substantial fraction of heating effect would be realized even if the house were built with glass area no greater than that found in orthodox structures. This does not mean that the additional glass area of a solar house is without advantage, but it does indicate that the performance of a solar house should be evaluated in terms of the performance of a comparable non-solar house rather than in terms of absolute radiation gains; in subsequent discussion all comparisons will be made on the former basis.

Overall Results

Generalizations from particular experiments on solar heating are dangerous and frequently untrustworthy. Parallel with the present experimental program a theoretical study is underway at Purdue University which, it is hoped, will provide an adequate generalized framework to permit correlation and limited extrapolation of the test data. Until such a correlation is available, however, great care should be exercised in using the results from the experiments described here in attempting to deduce the performance of other solar houses in different localities. Solar performance depends on the construction of the particular house, the range of outside temperatures, the quantity of direct sunshine and both the quantity and quality of solar energy received diffusely on days when the sun is obscured.

Table 2 — Degree-Hours of Heating

Required for Each Hour of December 17, 1945; Based on 65F and Tabulated in Terms of Recorded Air Temperatures (See Fig. 5).

Time	Outside	Orthodox	Solar
1 a.m.	65	44	47
2	65	44½	49
3	66	45½	50
4	67	46½	51½
5	68	47½	53
6 a.m.	69	48	54
7	69	49	56
8	67	49	51
9	63	46	42
10	57	43	30½
11	55	38	18
12 noon	53	34	8
1 p.m.	52	32	—1
2	51	30	—4
3	52	29½	1
4	54	33	11
5	55	35	18
6 p.m.	55	36½	23
7	55	37½	27
8	55	38½	30½
9	55	39	33
10	56	39½	35
11	56	40	37½
12 midnight	56	40½	39
Total Degree-Hours	1416	966	760

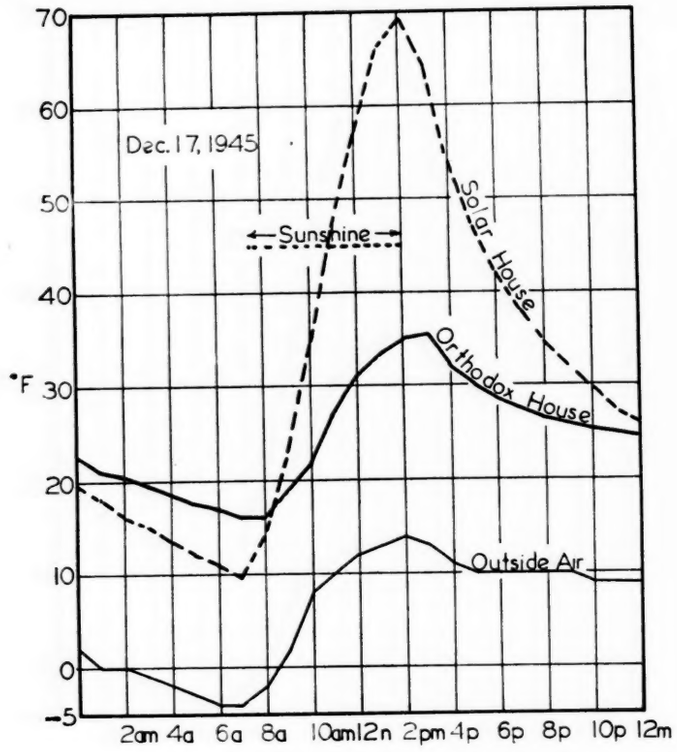


Fig. 5. A representative plotting of 24-hr data.

From the standpoint of general interest, however, and if considered in the light of the above warning, the specific results from this one group of tests are instructive in showing, qualitatively, the effectiveness of solar construction as a means of capturing short-wave-length radiant energy; further, the test data are indicative of the kind of performance which can be expected from a given type of house when erected in a locality where the climate is comparable to that of Lafayette, Ind. Referring to Table 1, and considering the overall results for the 9-week experimental period it appears that the solar house required 9% less degree-hours of heating than did the house of orthodox construction; in this same period the average outside temperature was 25.7F and there was direct sunshine for 12¼% (3 hours daily average) of the time. For some weeks the average sunshine was approximately 1 hour per day while for others it averaged over 6 hours.

A direct correlation between percent sunshine and percent reduction in degree-hours would not be expected since the latter percentage would be greatly influenced by the outside air temperature. Thus for two successive weeks having the same quantity of direct sunshine the greater reduction in degree-hour requirements would be expected to occur for the week during which the outside temperature was highest. It is interesting, however, to check this anticipated effect by plotting, for the 9 weekly periods, percent sunshine against percent reduction in degree-hours; this has been done in Fig. 6 where the dashed line has been drawn merely for purposes of illustration and should not be considered as indicating a recommended empirical relationship. Note from the figure that a very rough trend is indicated in that all points which fall below the dashed line are for weeks in which the average outside air temperature was unusually high and the consequent solar advantage was therefore substantially greater, for a given percentage of sunshine, than would otherwise have been the case. The one point seriously out of line with the correlation is that for the week ending February 2, 1946 during which period the average outside temperature was 24.6F. As evident from the last row of Table 1, data for this particular week are in such marked disagreement with all preceding results that it appears to be subject to definite question; lacking an adequate explanation of the reason for this disagreement the data has been given an equal place—though open to suspicion—with that from the other eight weeks of test.

An excellent though somewhat unexpected correlation has been obtained in Fig. 7 between percent sunshine and percent reduction in degree-hours for the solar house as compared with actual degree-hour requirements obtained from the outside air temperature. In using this figure it must again be emphasized that the very large reductions in degree-hours indicated on the figure cannot be entirely attributed to the solar construction since from one-half to two-thirds of this advantage would be realized in a house of orthodox construction. The fraction directly attributable to the solar construction is sufficiently great, however, to indicate that—for houses of equal equivalent overall coefficient—the solar house would afford an average saving in heat requirements of the order of 10%.

Conclusions

This progress report summarizes the results of a nine week experimental study of two test houses which are thermally and architecturally identical except that one is of orthodox construction with 12% of wall area in glass while the other is of solar construction with 22½% of wall area in glass; the excess glass of the solar house is entirely in the south and east walls. During the test period no heat was supplied to either house, but continuous records were kept of inside and outside air temperatures, hours of direct sunshine, wind direction and velocity. For the overall two month

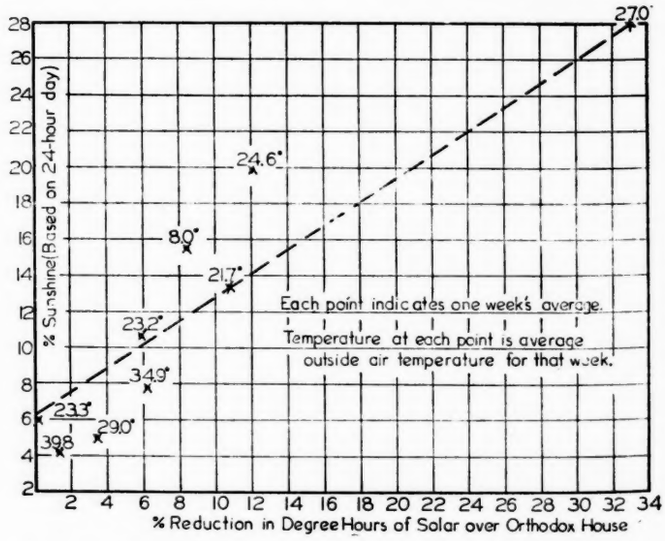


Fig. 6. Showing % sunshine against % reduction in degree-hours of solar over orthodox house data from Table 1. Dashed line is for illustration only.

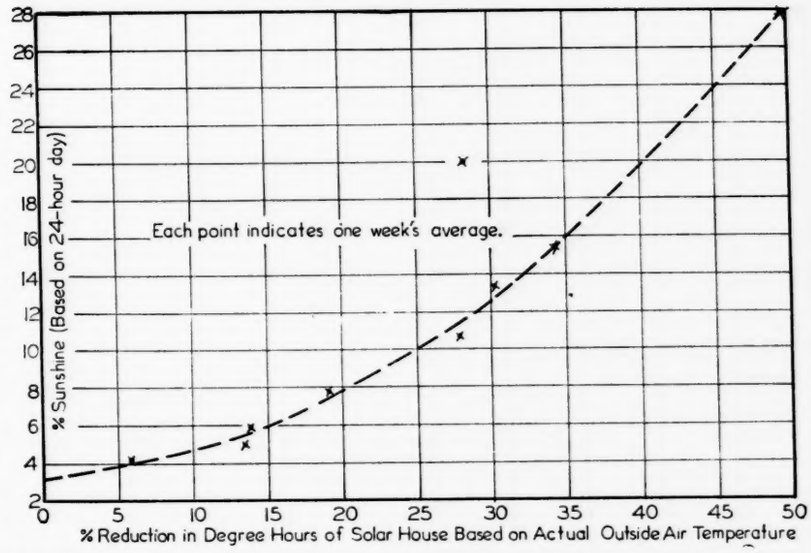

% Sunshine (Based on 24-hour day)
Each point indicates one week's average.
% Reduction in Degree Hours of Solar House Based on Actual Outside Air Temperature

Fig. 7. Correlation of sunshine and degree-hours.

period there was an average of 12¼% sunshine with average outside temperature of 26F and an average reduction of 9% in the degree-hours required for the solar house as compared with degree-hours required for the house of orthodox construction. If the houses had equal equivalent overall coefficients there would have been a 9% saving in heat requirements for the solar house; the houses do not have equal equivalent coefficients hence direct comparison of heating costs is not possible from the data which have been presented. Two additional test projects are now underway. The first involves determination of the degree-hour saving as a function of floor slab thermal capacity while the second is a study of comparative heating costs based on maintenance of fixed inside air temperatures in both houses by controlled electric space heating.

Refrigeration and Surgery

The present status of applications of refrigeration for surgical and medical purposes was reviewed by Frederick M. Allen, M.D., in a paper presented before the 1946 annual meeting of the American Society of Heating & Ventilating Engineers in January, in a paper titled "Therapeutic Uses of Low Temperature."

For a number of years Dr. Allen has been closely identified with cases in the City Hospital of New York where low temperatures, obtained either by ice or mechanical refrigeration, have been applied to bring about recovery or alleviate a condition. Partially based on his own experiences, and partially on reference from the literature, his paper summarized and classified for the non-medical man the types of conditions where these low temperatures have been successful. They include the following:

1. *Surgical anesthesia.* Cold is the only known anesthetic which anesthetizes not only nerves but also the entire protoplasm, and it thus provides the only shockless surgery. It was first used for the purpose of amputation in dangerous gangrene cases, particularly those which were formerly given up as inoperable because of weakness and shock. The cooling used is moderate (59F). Many surgeons have agreed that the mortality in poor-risk amputation cases has been greatly reduced by this method (in the City Hospital, N. Y., a change from about 80% deaths to about 80% recoveries).

2. *Infection and intoxication.* As an example, a patient may enter the hospital nearly dead with his leg infected and gangrenous. The leg is packed in ice. The intoxication is halted so that within 24 or 48 hours fever, delirium or unconsciousness are cleared up and the patient is eating.

3. *Brief preservation after wounds.* As an example, a man may arrive in the hospital in a dying state after amputation of both legs by a railway train. He revives under transfusions and other treatments, and pain is relieved by packing the stumps in ice. He is in condition for successful surgery 58 hours later, the wounds being fresh and free from odor.

4. *Prolonged preservation after wounds.* For example, if a man sustains fractures of the pelvis by being crushed by a truck or falling from a height, and as a result the main artery of one leg is damaged and clotted shut, amputation would be fatal in the presence of other severe injuries and shock. In cases reported, packing in ice prevented gangrene of the leg for 2 or 2½ weeks while other injuries were being treated and strength built up; then amputation was followed by recovery.

5. *Saving of limb.* A blast accident tore off one of a soldier's hands, mangled the other and inflicted body injuries. A quick wrist amputation might not have been fatal, but both forearms were packed in ice. After 2½ weeks there was sufficient recovery of strength for reconstructive surgery.

6. *Embolism.* Embolism in a limb means that an artery is stopped by a clot or other obstruction. Thus it occurs in heart disease and other conditions where the patient may be unfit for immediate operation. Refrigeration has preserved such limbs from gangrene for 2 to 6 weeks, until conditions for amputation were more favorable.

7. *Shock.* In shock arising from crushing or other severe injuries of limbs, life may be saved by refrigeration, as proved definitely by animal experiments.

8. *Injuries due to cold.* Frozen areas or "immersion foot" should not be warmed too fast or too far. By keeping the affected parts moderately cool, with skin temperatures around 60 to 70F, sometimes for several weeks, the neurovascular symptoms are greatly relieved and many amputations prevented.

9. *Burns.* Burns create a need for the potency of cold for controlling pain, shock, infection, necrosis and intoxication.

Pipe Sizing Charts for Hot Water Systems

For finding the friction loss in a given system, or the proper pipe size for a desired heat and friction load, the charts described are consistent with those which have appeared in previous issues.

THE accompanying charts were designed to show graphically the friction, as well as the heat carried, in steel (or iron) pipe and Type L copper tubing when the fluid is water at 175F temperature and with a 20F temperature drop. The temperature of 175F was chosen as meeting the requirements of both forced and gravity systems with reasonable accuracy, so that the charts are suitable for all forms of hot water heating.

Use of Charts

Use of the charts is best illustrated by examples, as follows:

Example. (a) What friction loss will there be in 84 ft of 1 inch steel pipe line with 175F water flowing at 0.8 ft per second? (b) How much heat will be carried by the water?

Solution. On Fig. 1 locate the intersection of the diagonal line marked 1 inch pipe with that marked 0.8 ft per second and find (a) on the bottom scale, a friction loss of 50 milinches per ft or 50 × 84 = 4200 milinches for the 84-ft line and (b) on the side scale find 21,000 Btu carried per hour with a 20F temperature drop.

Example. In proportioning a hot water system employing steel pipe, a 46-ft branch must have a friction drop of 3680 milinches and, based on a 20F temperature drop, carry 150,000 Btu per hour. What size pipe and what velocity will meet this condition?

Solution. The friction loss per foot of pipe must be 3680/46 = 80.0 milinches. Locate the intersection of 150 on the side scale and 80 on the lower scale, and find that a 2 inch pipe and a velocity of 1.5 ft per second meet the conditions.

Fig. 2, covering copper tubing is used in exactly the same manner.

Water Flow in Pipes

In 1941, Roy B. Hunter of the National Bureau of Standards developed, in connection with a study of cold water piping, a series of formulas for flow of cold water through pipes[1], based on the latest available data. In the publication cited, the author showed the derivation of his formulas, as follows:

Many empirical pipe flow formulas have been proposed in the past, some of which have been extensively employed by engineers with varyingly satisfactory results. In the use of formulas for estimating pipe capacities, apparently it is not always appreciated that the friction factor is not a constant for any particular class of pipe; it varies with diameter, roughness, and velocity, and it is impossible from present knowledge to predict with a reasonable degree of accuracy what the diameter and roughness of any particular pipe will be after a period of service. The question of what quantitative allowances to make for decrease of capacity depends largely on the character of the water in each case.

The equation of equilibrium among the forces determining the rate of flow through a pipe is commonly known as a pipe formula. The rational formula for fluid flow in pipes may be written in the form

$$\frac{h}{L} = \lambda \frac{v^2}{2gd} \qquad (1)$$

in which, using English units,

- h = the friction loss in head in feet of water,
- L = the length of pipe in feet,
- d = the diameter of the pipe in feet,
- v = the mean velocity in feet per second,
- g = the acceleration of gravity in feet per second per second, and
- λ = a dimensionless friction factor whose value depends on the Reynolds number and the roughness of the pipe.

The Reynolds number, R_e, is a dimensionless number defined as

$$R_e = \frac{dv\rho}{\mu} = \frac{dv}{\gamma} \qquad (2)$$

- ρ = the density of the water in pounds mass per cubic foot,
- μ = the absolute viscosity of the water in pounds mass per foot per second, and
- γ = the kinematic viscosity of the water ($= \mu/\rho$) in square feet per second.

For the flow of an incompressible fluid, such as water, in a smooth pipe, a unique relation exists between λ and R_e which may be expressed mathematically as

$$\lambda = \text{function} \frac{(dv)}{\gamma} \qquad (3)$$

and which for smooth pipe may be represented graphically as in Fig. 3 by curve 1.

For pipes that are not smooth, the relation λ = function (dv/γ) gives a series of curves, one for each diameter, and each particular roughness, lying above the single curve for smooth pipe.

Equation 1 is accurate for computing the mean velocity of flow under a given or allowable loss in head or for computing the loss in head for a given or required rate of delivery, provided the λ-R_e relation is

[1]Published in Report BMS 79, Water Distributing Systems for Buildings, by Roy B. Hunter. Available from Superintendent of Documents, Washington, 15 cents.

known, as is the case for smooth pipe, and provided the density and viscosity are also known. However, the temperature and character of the water in water-distributing systems, on which the density and viscosity depend, will vary not only from system to system, but from day to day and from season to season in the

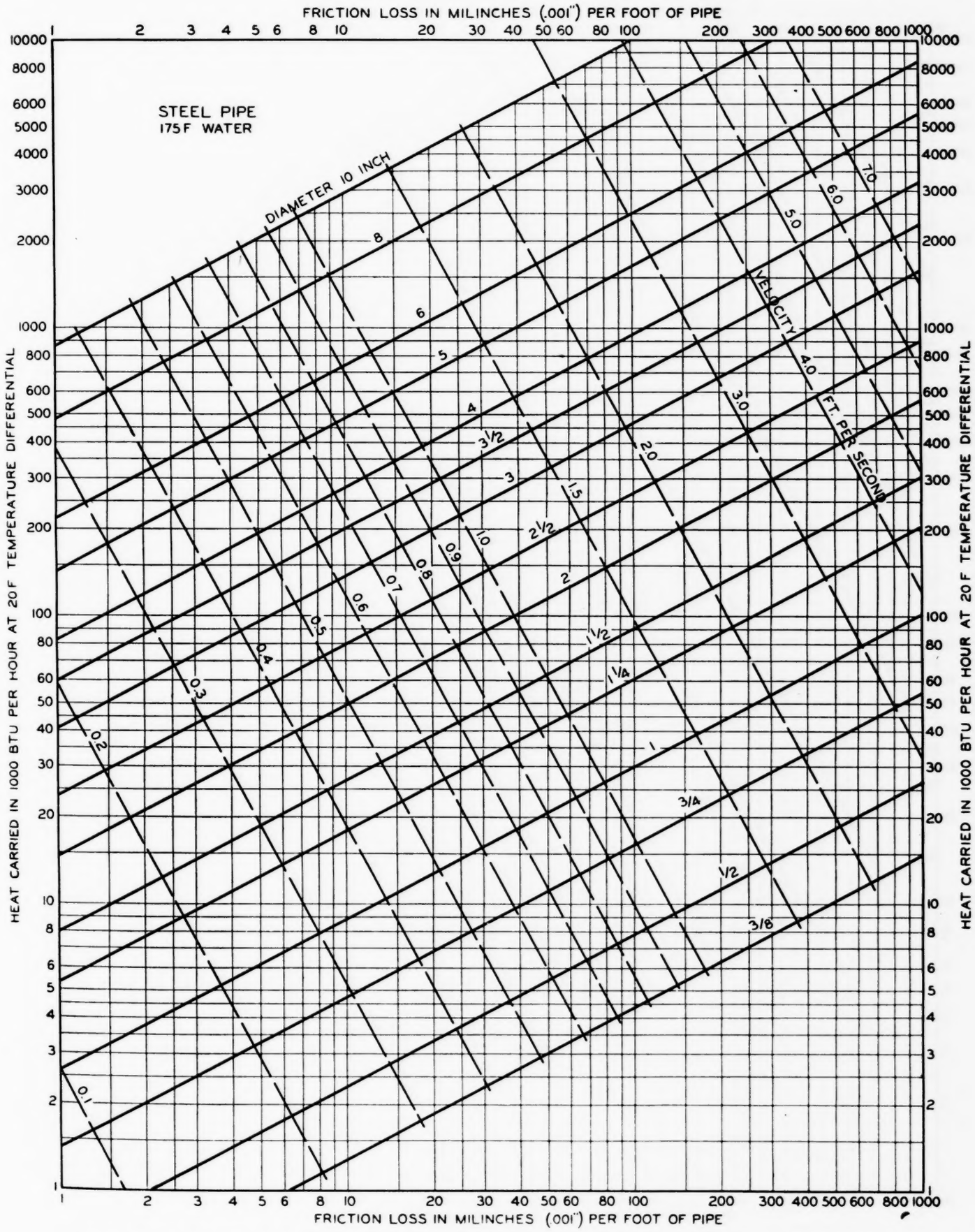


Fig. 1. Chart for deriving heat carrying capacity, friction loss, pipe size, and velocity in steel pipe at 175F.

same system. A high degree of accuracy is neither practical nor necessary in the proposed application, and hence equation 1 may be simplified by making two assumptions: (1) that the relation between λ and R_e is represented by an equation of the form

$$\lambda = bR_e^{-a} \quad \text{..... (4)}$$

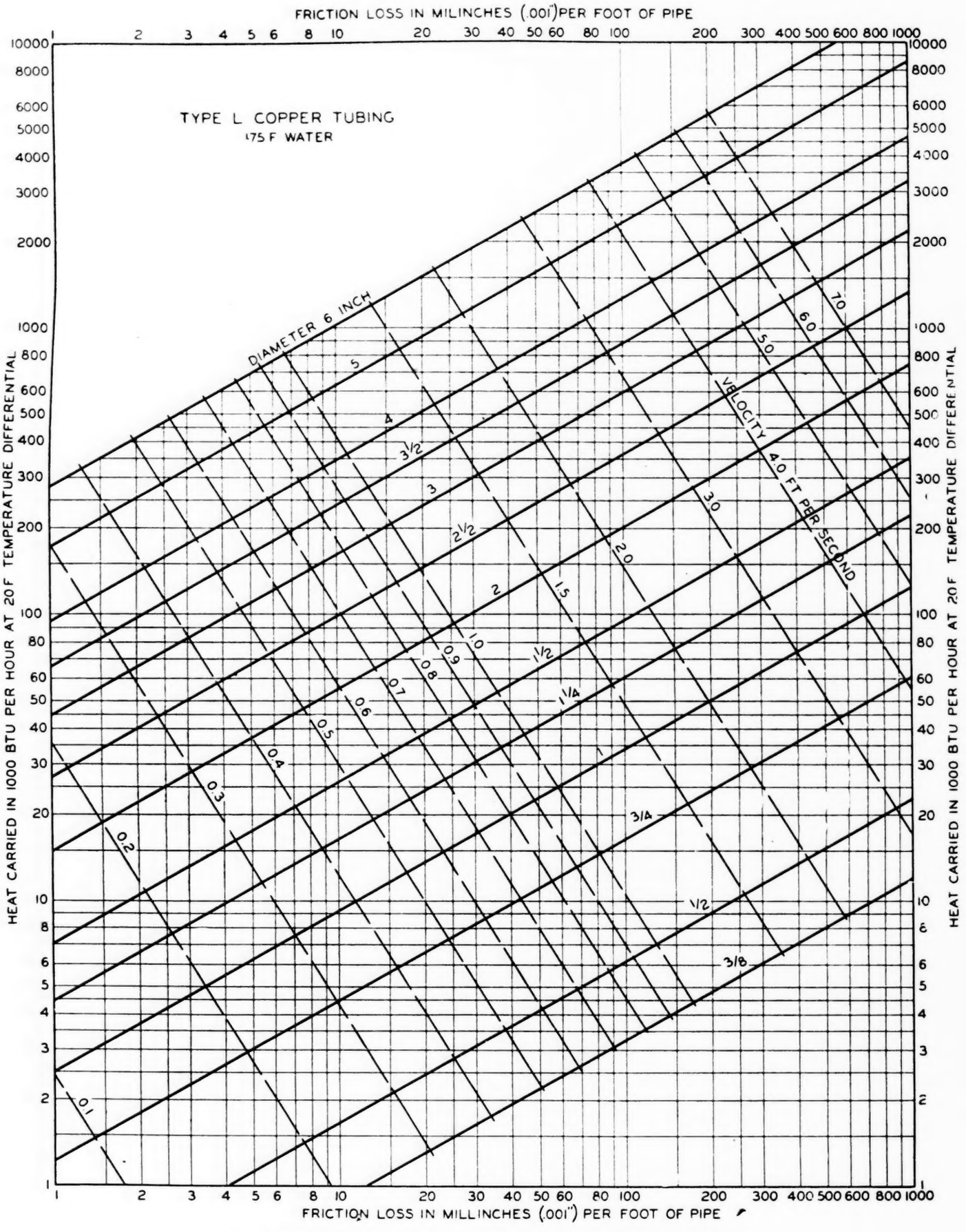


Fig. 2. Same data as in Fig. 1, derived for Type L copper tubing.

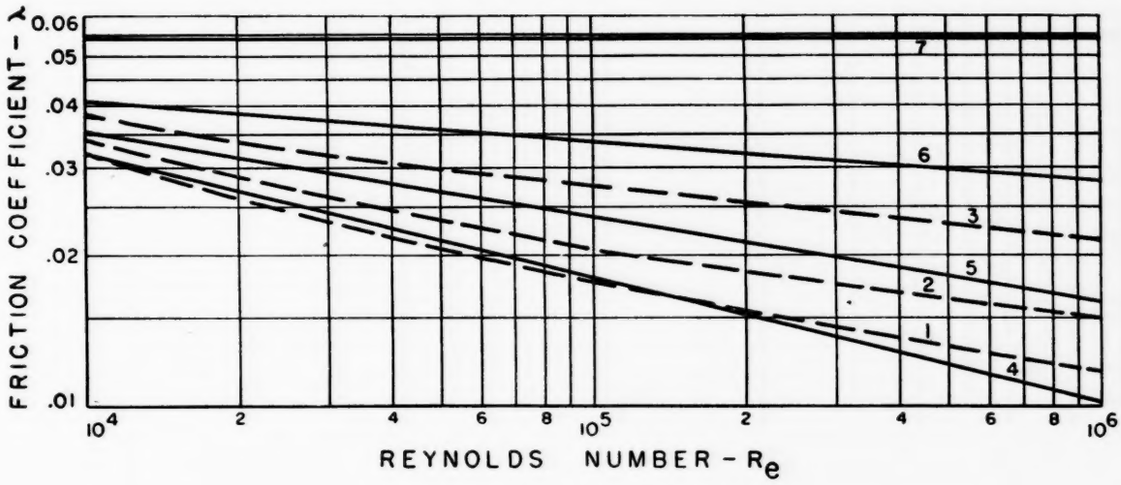


Fig. 3. Variation of friction coefficient with Reynolds number for various pipes.

and (2) that the variations in ρ and μ with temperature are negligible in comparison with the accuracy required.

Equation 4 gives a straight line when plotted logarithmically. Hence, an approximate formula for application over a limited range of Reynolds numbers may be derived from the rational formula (equation 1) by drawing the straight line best representing curve 1 in Fig. 3 over the selected range in Reynolds numbers and then in evaluating the Reynolds number, by substituting values of ρ and μ for the midrange in temperatures likely to be encountered in building water-supply lines of 6-inch diameter and smaller.

$R_e = vd/0.0000141$ for pure water at 50F temperature, which is probably a fair average temperature for cold-water lines. By substituting this value of R_e in equation 4 and the resultant value of λ in equation 1, the latter reduces to

$$\frac{h}{L} = 0.000\,304 v^{1.75}/d^{1.25} \quad \text{.....(5)}$$

This formula gives close approximations for smooth straight copper tubing, copper pipe, and other straight pipes of similar smoothness, provided the actual inside diameters are used, but do not give as accurate results for Reynolds numbers above 200,000 as in the lower range.

As pointed out in the discussion of the rational pipe formula, the relation between λ and R_e for rough pipe cannot be represented by a single curve for all diameters as can be done for smooth pipe. Hence a single formula for rough pipe will not give as accurate results as equation 5 does for smooth pipe. However, estimates made for a limited range in pipe diameters by means of a formula applying strictly to an intermediate diameter only in that range will be sufficiently close for practical purposes of selecting supply-pipe sizes for buildings, since the effects of different waters on capacity cannot ordinarily be estimated with as great an accuracy.

A very complete analysis of available flow data on both new and old pipe is given in a paper by Kemler which shows the variation of the friction constant with diameter that may be expected in new pipes not in the category of smooth pipe, and which also shows the wide variation in the friction factor for old pipe of nominally the same kind. Considering these variations and the fact that the actual friction coefficient and actual diameter of a pipe after it has been in service as a water conductor vary over rather wide ranges, it would appear that a few formulas representing different degrees of roughness are sufficient for estimating the capacities of water-supply pipes over a limited range in Reynolds numbers with a greater precision than the accuracy to which the diameters and roughness of pipes in service can be predicted from information now available. Accordingly, it is suggested that water-supply pipe be considered in four classes as to hydraulic roughness:

(1) Smooth pipe, in which class new copper or brass tubing with so-called streamlined fittings and brass pipe may be categorically placed;

(2) Fairly smooth pipe, in which class butt-welded steel and wrought-iron pipe with threaded fittings may be placed;

(3) Fairly rough pipe, which represents a roughness intermediate between fairly smooth and rough pipe; and

(4) Rough pipe, in which class any kind of badly corroded or badly caked pipe may be placed.

These are classifications made arbitrarily by Mr. Hunter for the purpose of presenting flow information in a concrete usable form, and except for smooth pipe, they are not based directly on experimental data on any particular kinds of pipe.

Kemler's analysis of the flow data relating to new welded-steel and wrought-iron pipe, which may be classified as fairly smooth pipe, shows λ-R_e curves ranging from curve 2 (Fig. 3) for 6-inch pipe to curve 3 (Fig. 3) for 1/2-inch pipe, with the curves for intermediate sizes lying in order of size between these limits. If a straight line (line 5, Fig. 3) is now drawn intermediate between curves 2 and 3 and an approximate formula based on values of λ represented by that line, the capacities computed by that formula will be in error by varying amounts—except for particular diameters and particular values of the Reynolds number—ranging for 1/2-inch pipe from about + 3.5% with a Reynolds number of 10,000 to about + 5.5% with a Reynolds number of 250,000 and ranging for 6-inch pipe from about — 2.0% with a Reynolds number of 10,000 to about — 7.0% with a Reynolds number of 250,000. The errors for intermediate sizes of pipe will be correspondingly less in the same range of

Reynolds numbers, and the results will be approximately correct for diameters of 2 to 4 inches. These errors are negligible in comparison with the accuracy with which the load and the actual diameter and roughness of pipes in service can be predicted.

The equation of line 5 is $\lambda = 0.17\ R_e^{-0.17}$. Proceeding in the same manner as for smooth pipe, by substituting this value of λ in equation 1, the corresponding formula for fairly smooth pipe is:

$$\frac{h}{L} = 0.000396v^{1.83}/d^{1.17} \quad \text{.....(6)}$$

The experimental data for flow of water in rough pipe indicate that λ is approximately constant for each diameter of very rough pipe, not introducing contraction effects, over all ranges of the Reynolds number. Hence, the relation between λ and R_e for very rough pipe will be represented by a series of horizontal lines each applying to a particular diameter. The selection of the value of λ for use in application to this class of pipe is largely a matter of judgment. $\lambda = 0.054R_e^{0.0} = 0.054$, represented by line 7 in Fig. 3, seems to be a reasonable value for application in the range of diameters considered in deriving formulas for smooth and fairly smooth pipe.

Likewise, the selection of the value of λ for a class of pipe intermediate in roughness between fairly smooth and very rough is a matter of judgment. The relation $\lambda = 0.085R_e^{-0.08}$, represented by line 6, was selected for the degree of roughness designated as fairly rough pipe.

Using these values of λ in the same manner as in deriving the formulas for smooth and fairly smooth pipe, the following formula was obtained in which the same notation is employed.

Formula for fairly rough pipe:

$$\frac{h}{L} = 0.000540v^{1.92}/d^{1.08} \quad \text{.....(7)}$$

Formula for rough pipe:

$$\frac{h}{L} = 0.000838v^2/d \quad \text{.....(8)}$$

The foregoing formulas *for 50F water* can be expressed, when d is in inches, as:

Smooth	$h = 0.00682v^{1.75}/d^{1.25}$
Fairly Smooth	$h = 0.0073v^{1.83}/d^{1.17}$
Fairly Rough	$h = 0.008v^{1.92}/d^{1.08}$
Rough	$h = 0.0101v^2/d$

where

h = friction loss in feet of water per foot of pipe (L = 1);
v = velocity, feet per second; and
d = inside diameter of pipe, inches.

If any two of the variables in the formulas given in three variables are plotted on logarithmic paper for a constant value of the third factor, the resulting curve is a straight line. These logarithmic charts, for the four types of pipe smoothness, and *for 50F water*, have previously appeared in HEATING AND VENTILATING.[2]

* * *

Following the same theory as outlined in the foregoing and using the same basic formulas, but substituting a value for the viscosity of water at 175F instead of that for 50F water, the following formulas result:

(1) Smooth:	$h = 60v^{1.75}/d^{1.25}$
(2) Fairly Smooth:	$h = 72v^{1.83}/d^{1.17}$
(3) Fairly Rough:	$h = 84v^{1.92}/d^{1.08}$
(4) Rough:	$h = 120v^2/d$

where

h = friction head in milinches per foot of pipe;
v = velocity in feet per second; and
d = actual inside diameter in inches.

The formulas selected for plotting were (1) and (3), that for (1) being shown in Fig. 2, and for which values of d were those for Type L tubing, while (3) is shown in Fig. 1. The fairly rough formula was used so that, as the pipe ages, corrodes and scales, the friction values will still be ample.

[2] "16 Steps in Sizing Piping for Cold Water Supply," H & V, Feb., 1942; H & V's Reference Data 231-232, 233-234; "Fundamentals of Fluid Flow," by J. M. Dalla Valle, H & V, April, 1945.

Rollers Eliminate Scratches on Sheets in Shear

A roller attachment added to a shear at the Westinghouse Appliance Division, Mansfield, Ohio, has decreased production costs and eliminated scratches during the fabrication of large aluminum sheets.

Without this roller, three operators were required to feed the sheets from a table at the back to the operator at the front of the shear. When the sheets were fed into the shear they would rub against the bottom blade causing deep scratches which made it necessary to metal finish them before they could be used.

A great part of the labor involved in both the feeding operation and the metal finishing was eliminated by the addition of the roller. One operator was eliminated at the back of the shear and the scratches were almost entirely eliminated.

After the holding plates are attached to the machine, the roller is easy to mount or dismantle as there are only two bolts holding it in position. The roller is attached to the top blade so that it is positioned 1/16 of an inch above the bottom blade. This allows the aluminum sheet to be rolled over the bottom blade without scratching it.

IT WAS shown in an article some time ago that heat gains in winter can be important from the standpoint of fuel estimating; that is, the total of heat gains is great enough to affect predicted fuel consumption as much as 25%.[1] Further, it was shown that, based on estimates for a typical residence, the sun heat gain can be a substantial part of the total gain; in fact, the estimated gain from the sun was nearly 12% of the estimated heat loss. Any component of such importance would seem to warrant at least some attention, but unfortunately, computation of winter solar heat gain is a laborious task. It is the purpose of this article to attempt to organize at least some of the data needed in estimating winter sun heating gain, for use in such cases where a study of this factor may be of consequence.

Data Necessary

The work that has been done during the last decade in organizing the information necessary to calculate sun heat loads in summer (when solar heat gain is a severe problem) has been so extensive that many of the needed data are already available. The information needed includes figures for (1) intensity of sunlight by hour by months; (2) cosine of the angle, by hour and by months, between the sun's rays and the given wall or window; (3) percentage of sun energy absorbed by the surface, a function of color and roughness; (4) effect of shading on the wall or window, (5) the number of hours of sunshine by months in the community in question, and (6) percentage of energy absorbed which is transmitted by the wall.

Data are available on points (1) to (4) inclusive, although those for (1) still leave much to be desired. Data for (5) are presented here, perhaps for the first time in a form useful to heating men, although these data, too, have marked limitations. Figures for (6) are still in question.

For a given wall and for a given hour and given month, the heat transmitted into a room is:

$$H = I \times \text{CosX} \times b \times g \times A$$

and through a given window:

$$H = I \times \text{CosX} \times S \times A$$

where H is heat transmitted for the wall or window in Btu per hr, I is the intensity of solar energy in Btu per sq ft per hr for the given hour and month; X is the angle between the sun's rays and the wall or window at the given hour and for the given month, b the decimal part of solar energy absorbed by the surface, g the decimal part of that absorbed which is transmitted, S the decimal part of that incident to a window relative to no shading (it being assumed that all of that energy falling on a glass window will be transmitted to the room; this is not true, but is probably sufficiently accurate), and A the area in square feet of the wall or roof.

It is not an especially long or tedious job to calculate the heat gain for a wall or window area for a given hour; the task does become tiresome, however, when this calculation is repeated for each hour of the day for each month in the heating season. To simplify the work involved, b, g and A can be reduced to a constant for each wall, and S and A to a constant for each wall's windows.

Sun Intensity

The radiant energy from the sun is considerably reduced by the atmosphere so that the value of I is relatively low in the early morning and late afternoon hours and in the winter months. Table 2 is an estimate of I, by hours and by months, *normal to a surface*. The footnote to this table indicates the source of the data. These figures are for a bright sunny day only.

Heat Absorbed

Only a portion of the radiant energy which succeeds in getting through the atmosphere is absorbed by the surface on which it falls; the remainder is

[1] See "Winter Heat Gains Are Important in Fuel Consumption Estimates," HEATING AND VENTILATING, July, 1942, page 50.

Table 1—Average Number of Sunshine Hours in a Normal Heating Season

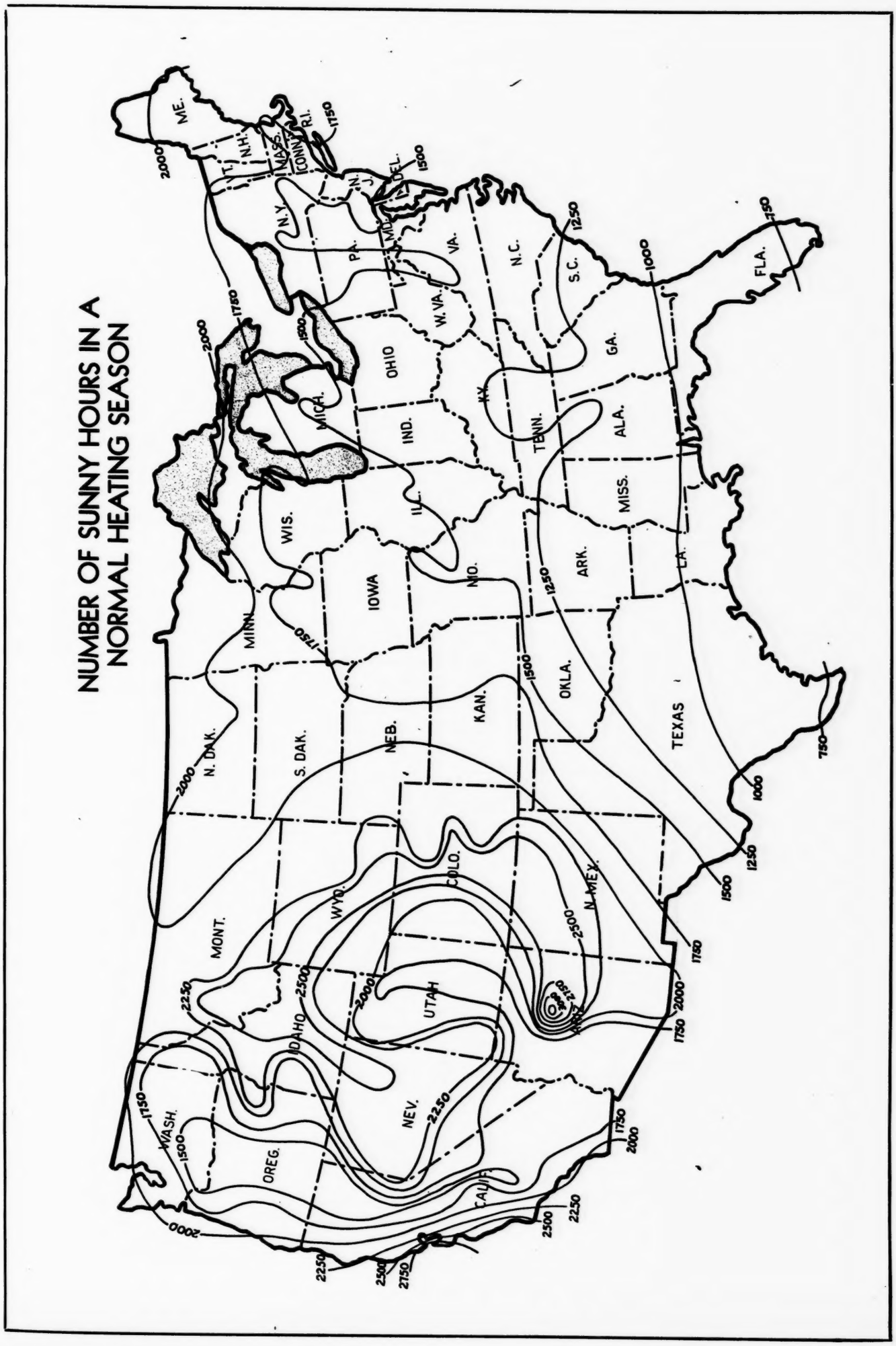
City and State	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total
Albany, N. Y.	115	157	192	210	248	28	—	—	140	161	114	105	1470
Albuquerque, N. M.	233	230	285	306	341	222	—	—	68	285	243	236	2449
Atlanta, Ga.	161	160	202	213	—	—	—	—	—	160	195	140	1231
Baltimore, Md.	143	165	192	228	151	—	—	—	16	217	171	143	1426
Birmingham, Ala.	158	160	198	339	—	—	—	—	—	117	210	130	1204
Bismarck, N. D.	146	171	211	249	264	182	—	47	231	189	147	130	1967
Boise, Ida.	109	143	214	261	332	161	—	—	216	233	150	121	1940
Boston, Mass.	140	171	205	231	263	85	—	—	152	195	144	143	1729
Burlington, Vt.	93	151	183	207	239	114	—	—	201	152	90	78	1508
Chattanooga, Tenn.	136	151	189	222	—	—	—	—	—	169	195	124	1186
Cheyenne, Wyo.	195	196	242	267	276	324	21	87	264	239	195	183	2489
Cleveland, O.	90	112	164	198	279	58	—	—	133	183	105	78	1400
Columbia, S. C.	164	174	217	176	—	—	—	—	—	117	210	149	1207
Concord, N. H.	124	168	205	228	254	314	—	43	225	186	135	127	2009
Dallas, Tex.	167	165	211	118	—	—	—	—	—	107	189	152	1109
Davenport, Iowa	133	162	205	234	248	—	—	—	85	208	159	127	1561
Denver, Colo.	211	210	248	273	295	109	—	—	182	254	213	198	2193
Detroit, Mich.	96	129	177	204	279	57	—	—	137	180	114	78	1451
Eugene, Ore.	102	126	161	210	229	270	96	115	216	202	99	99	1925
Harrisburg, Pa.	124	148	186	210	227	—	—	—	85	186	150	124	1440
Hartford, Conn.	140	171	198	228	248	67	—	—	158	202	144	130	1686
Helena, Mont.	124	154	220	243	257	272	105	124	237	198	135	112	2181
Huron, S. D.	158	179	211	252	270	100	—	—	200	205	168	146	1889
Indianapolis, Ind.	118	148	177	222	187	—	—	—	58	217	159	115	1401
Jacksonville, Fla.	183	179	224	—	—	—	—	—	—	—	195	164	945
Joliet, Ill.	121	154	195	243	295	21	—	—	138	223	153	118	1661
Lincoln, Neb.	177	182	226	249	235	—	—	—	74	229	180	155	1707
Little Rock, Ark.	152	162	208	211	—	—	—	—	—	142	189	146	1210
Louisville, Ky.	124	148	186	222	94	—	—	—	—	204	168	118	1264
Madison, Wis.	127	157	195	231	276	73	—	—	167	186	135	118	1665
Minneapolis, Minn.	140	171	202	246	264	69	—	—	180	186	135	121	1714
Newark, N. J.	146	171	202	231	221	—	—	—	80	202	156	146	1555
New Orleans, La.	171	149	217	—	—	—	—	—	—	—	156	149	842
Phoenix, Ariz.	233	241	301	69	—	—	—	—	—	—	264	236	1344
Portland, Me.	124	174	205	225	263	230	—	52	225	189	138	140	1965
Providence, R. I.	140	171	205	228	263	124	—	—	177	198	150	143	1799
Raleigh, N. C.	164	174	211	252	19	—	—	—	—	166	201	158	1345
Reno, Nev.	140	174	246	285	326	320	—	12	324	264	201	140	2432
Richmond, Va.	161	171	205	240	95	—	—	—	—	199	183	149	1403
St. Louis, Mo.	146	162	211	243	86	—	—	—	—	220	177	133	1378
Salt Lake City, Utah	140	151	214	258	277	91	—	—	143	242	186	158	1860
San Francisco, Cal.	143	168	226	270	279	315	326	295	264	260	180	155	2881
Seattle, Wash	56	98	177	207	233	249	295	270	177	121	57	59	1999
Topeka, Kans.	171	179	229	237	167	—	—	—	26	233	189	158	1589
Tulsa, Okla.	167	174	220	225	54	—	—	—	—	185	189	161	1375
Vicksburg, Miss.	158	165	208	100	—	—	—	—	—	80	198	146	1055
Wheeling, W. Va.	87	112	155	195	174	—	—	—	83	186	114	81	1187
Wilmington, Del.	146	168	198	228	174	—	—	—	48	214	171	146	1493

Table 2—Intensity of Sun Heat Normal to a Surface†

(In Btu per Sq Ft per Hour)

Month	Time of Day												
	A.M.							P.M.					
	6	7	8	9	10	11	12	1	2	3	4	5	6
January	—	71	88	95	102	104	106	104	102	95	88	71	—
February	—	91	113	122	131	133	136	133	131	122	113	91	—
March	74	124	154	166	178	181	185	181	178	166	154	124	74
April	97	163	202	220	234	239	244	239	234	220	202	163	97
May	117	195	242	262	280	285	291	285	280	262	242	195	117
June	127	213	264	286	306	312	318	312	306	286	264	213	127
July	128	214	266	288	308	314	320	314	308	288	266	214	128
August	120	200	250	270	290	295	300	295	290	270	250	200	120
September	104	174	216	234	250	255	260	255	250	234	216	174	104
October	—	137	170	184	197	201	205	201	197	184	170	137	—
November	—	100	124	134	143	146	149	146	143	134	124	100	—
December	—	—	94	102	108	111	113	111	108	102	94	—	—

†Noon figures by months are from Smithsonian Physical Tables; hourly figures for August from ASHVE *Guide*. Hourly figures in above table (except August) calculated by proportion between the two sets of data.


NUMBER OF SUNNY HOURS IN A
NORMAL HEATING SEASON
ME.
VT.
N.H.
MASS.
CONN.
R.I.
N.Y.
N.J.
PA.
MD.
DEL.
VA.
W. VA.
OHIO
KY.
N.C.
S.C.
GA.
FLA.
MICH.
IND.
TENN.
ALA.
WIS.
ILL.
MISS.
MINN.
IOWA
MO.
ARK.
LA.
N. DAK.
S. DAK.
NEB.
KAN.
OKLA.
TEXAS
MONT.
WYO.
COLO.
N. MEX.
IDAHO
UTAH
NEV.
WASH.
OREG.
CALIF.
2000
1750
1500
1250
1000
750
2250
2500
2750

reflected back into space. The amount absorbed depends on the color and other characteristics of the surface on which the energy falls, light colored smooth surfaces reflecting more and absorbing less, dark colors and rough textures reflecting less and absorbing more. An indication of the extent to which colors affect this absorption is given in Table 3.

Table 3 — Solar Radiation Absorbed by Walls and Roofs (b)[1]

Color of Wall or Roof	Decimal Part of Radiation Absorbed
White	0.25 to 0.40
Gray to Dark Gray	0.40 to 0.50
Green, Red, Brown	0.50 to 0.70
Dark Brown, Blue	0.70 to 0.80
Dark Blue, Black	0.80 to 0.90

[1]More complete data, classified by material, and including brick, metals, paints and roofing materials, appear on H & V's Reference Data 83-84.

Heat Transmitted

Again, only a portion of the energy absorbed by a surface is transmitted. Data are available showing this ratio (which is related to the usual heat transmission coefficient) for summer heat gain. It is questionable whether these figures apply in winter. In summer the sun builds up a high surface temperature on the outside wall; in winter the low outside air temperature reduces this sharply; instead of being an additive component as in summer, the solar heat gain tends to offset the heat loss in winter. However, Table 4 is included as a rough guide.

Table 4 — Solar Radiation Transmitted by Walls and Roofs (g)

Heat Transmission Coefficient U for Wall or Roof	Decimal Part of Radiation Transmitted to Inside
0.10	0.02
0.15	0.03
0.20	0.04
0.25	0.05
0.30	0.062
0.35	0.075
0.40	0.085
0.45	0.095
0.50	0.105
0.60	0.13
0.70	0.15

Shading

Since it is assumed that all of the heat absorbed is transmitted through windows, it is desirable in summer calculations to allow for shading. In the summer the purpose of shading is to keep out the sun; in winter, blinds should be open to aid this heat flow. For that reason, the shading factors in Table 5 are somewhat misleading; nevertheless, they are probably applicable if judgment is used.

Sun Angles

Determination of the angle between the sun's rays and a given wall or roof has long since been reduced to a simple matter, although most tables omit figures for winter months. Charts and tables are available, however, which cover the whole year, and which permit relatively easy determination of the incident angle.[2]

Sunshine Hours

Obviously all of these data are of little use if the number of sunny hours is not known. For that reason Table 1 is presented. After determining the heat gain for each hour of the day for one day per month, the average per hour can then be multiplied by the number of hours of sun for that month as given in Table 1.

Table 5 — Shading Factors for Windows (S)

Type of Shading	Decimal Part of Radiation Relative to No Shading
Total shading	0
Heavy tree shade	0.20 to 0.25
Light tree shade	0.50 to 0.60
First floor awnings	0.25 to 0.30
Upper floor awnings	0.15 to 0.20
Inside window shade, drawn	0.45 to 0.55
Inside Venetian blind[1]	0.45 to 0.55
Outside Venetian blind[1]	0.20 to 0.35
Inside draperies, light color	0.80 to 0.90
No shading	1.0

[1]Fully drawn and with slats at 45°.

Table 1 is based on maps giving the average number of hours of sun per day for each of the twelve months.[3] These averages were multiplied by the number of days per month for those months in the heating season; for the months in which the heating season begins or ends, the number of days used was the number of days in that month which fall within the normal heating season.[4] The normal yearly totals are plotted in the map, Fig. 1, to show graphically the distribution of sunny hours. In interpreting this map, it should be kept in mind that both the average sunshine and length of heating season enter into the picture. In other words, the large number of sunny hours in the North is largely due to the longer heating season, and not necessarily to more sunny days per year of twelve months.

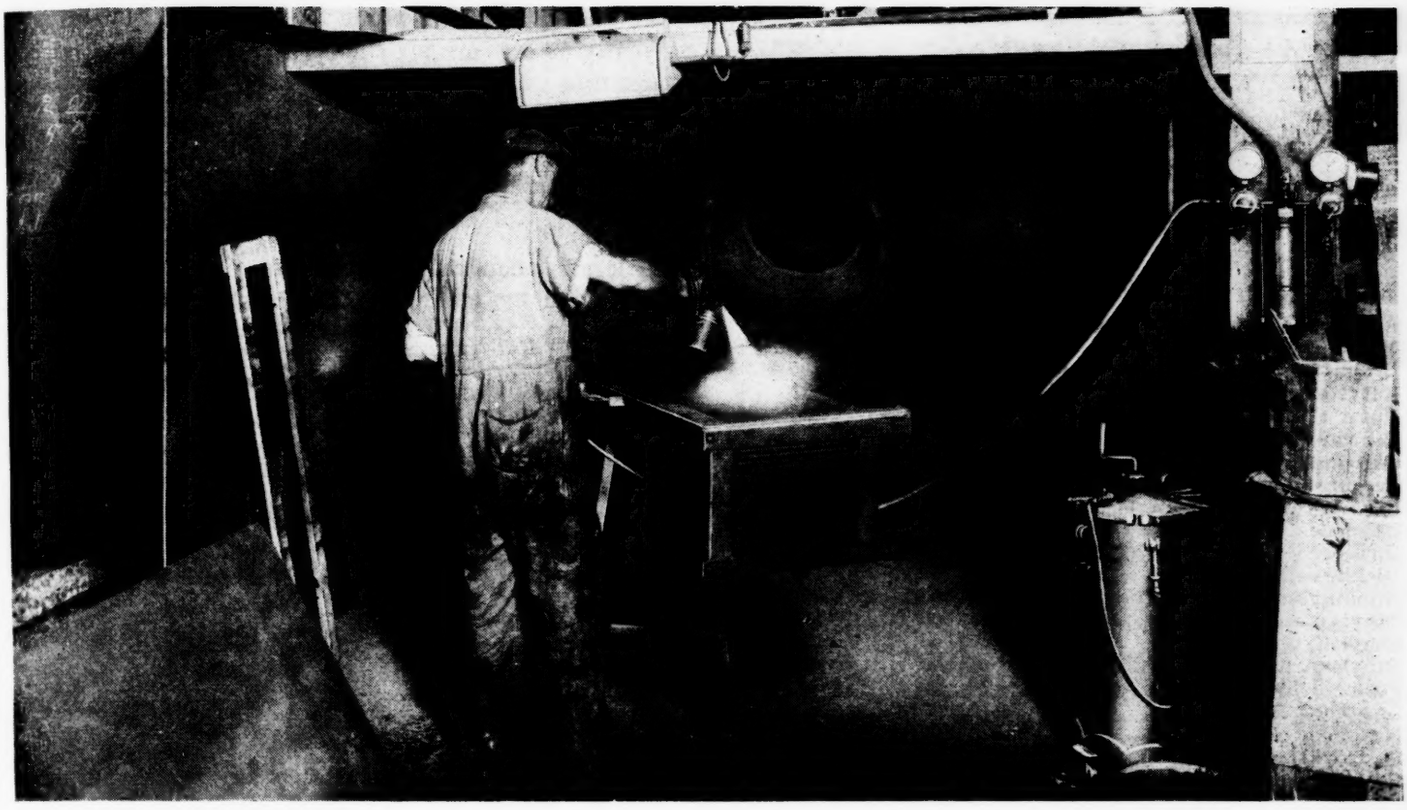
The figures in the map and in Table 1 cannot be taken literally when combined with Table 2, because available data on sun hours are not accurate as to sun intensity. The sun may or may not be shining with the intensity shown in Table 2 to be reported in Table 1. However, no data are available as to exactly what correction to make.

In conclusion, it is emphasized that the data presented here are probably subject to considerable criticism. They are published with the hope that they may stimulate thought and perhaps research on the subject so that the estimates of fuel consumption can perhaps be made more precisely than at present.

[2]See "Where Is the Sun?" by Wilson and Van Swaay, Heating and Ventilating, May and June, 1942.

[3]From the excellent publication of the U. S. Weather Bureau, "Atlas of American Agriculture, Section B," by Joseph B. Kincer, presently Principal Meteorologist and Chief of the Division of Climate and Crop Weather.

[4]See "Date Heating Season Begins in a Normal Year" and "Date Heating Season Ends in a Normal Year," Heating and Ventilating, October and November, respectively, 1937.



Guides for Industrial Ventilation

ALLEN D. BRANDT
Senior Sanitary Engineer, U. S. Public Health Service, Safety and Security Division OCO, Army Service Forces, Chicago.

Basic considerations and rules are presented for the industrial engineer concerned with contaminated air.

INDUSTRIAL hygiene, by definition, embraces all phases of industrial sanitation but by common usage it pertains mostly to the sanitation and quality of the industrial atmosphere, including conditions such as radiant heat and illumination which are manifested through the atmosphere. The importance of industrial hygiene in good labor-management relationships, in low cost of production, in reduced absenteeism, and in lower accident frequency is well established.

Even though considerable work was being done in the field of industrial hygiene engineering prior to World War II, and the activities in this connection were increased a great deal during the war, the state of industrial hygiene today is far behind most of the other fields of sanitary or public health engineering. This is particularly true of industrial atmospheric sanitation which is one of the most important, if not the most important, phases of industrial hygiene.

Industrial air must be within certain tolerances. To keep its degree of contamination below the limits given in Table 1, industrial hygiene engineers resort to a variety of control measures. They are (1) change of operation, (2) substitution of less toxic material, (3) inclosure of source of contamination, (4) segregation and isolation of offending processes, (5) good housekeeping, (6) substituting wet for dry operations, (7) local exhaust systems, and (8) general ventilation. In addition, the amount of the toxic material inhaled may be reduced by having the exposed employees wear appropriate respirators. Which measure, or combination of measures, is best for a given set of conditions will depend upon the nature of the material, nature of dispersion, and the toxicity of the material. Only the experienced industrial hygiene engineer is in a position to recommend the most efficient control procedures.

Of the foregoing measures, local exhaust systems and general ventilation are among the most important.

General Ventilation

Fundamentally there is little important difference between the construction of a general process ventilating system and the usual industrial ventilating system. There is, however, a very important difference in the basis for design. Most general ventilating systems observed by the author were based on some simple rule-of-thumb formula for the operation under consideration. Results are usually given in air changes

Table 1 — Maximum Allowable Concentrations

Substance	Maximum Allowable Concentration* in ppm	
Acetone	400 to 500	(1)
Acrolein	1	
Acrylonitrile	20	(1)
Ammonia	100	
Amyl acetate	400	(1)
Amyl alcohol	400	(1)
Aniline	5	
Arsine	1	
Benzene (Benzol)	50 to 100	
Bromine	1	(1)
Butyl acetate	400	(1)
Butyl alcohol	200	(1)
Carbon dioxide	5000	
Carbon disulfide	20	
Carbon monoxide	100	
Carbon tetrachloride	50 to 100	
Chlorine	1	
Dichlorobenzene	75	
Dichloroethylene	100	(1)
Dimethylaniline	Similar to aniline	
Ethyl acetate	400	(1)
Ethyl alcohol	500 to 1000	(1)
Ethylene dichloride	100	(1)
Formaldehyde	10	
Gasoline (Benzine)	1000	
Hexanone	150 to 200	(1)
Hydrogen chloride	10	
Hydrogen cyanide	20	
Hydrogen fluoride	3	
Hydrogen sulfide	20	
Methyl acetate	400	(1)
Methyl alcohol	200	
Monochlorobenzene	75	(1)
Mononitrotoluene	Similar to nitrobenzene	
Naphtha (Petroleum)	1000	
Nitrobenzene	5	
Nitrogen oxides	25	
Petroleum naphthas	1000	
Phosgene	1	
Phosphine	1	
Propyl acetate	400	(1)
Stoddard solvent	1000	
Styrene monomer	400	
Sulfur dioxide	10	
Tetrachloroethane	10	
Tetrachloroethylene (Perchlorethylene)	200	
Toluene (Toluol)	200	
Trichlorethylene	200	
Turpentine	200	
Xylene (Xylol)	200	

Substance	Maximum Allowable Concentrations* in MG per Cu Meter	
Arsenic and arsenic trioxide	0.15	(2)
Barium peroxide	0.5	(1)
Cadmium	0.1	
Chromic acid	0.1	
Lead	0.15	
Manganese	6.0	
Mercury	0.1	
Dinitrotoluene	Similar to TNT	
Tetryl	1.5	(1)
TNT	1.5	
Zinc oxide	15.0	
Silica (SiO_2) (free or uncombined)		5 mppcf
Nuisance dusts		50 mppcf

*The maximum allowable concentrations for the various substances listed are the values most widely accepted today and are based on an 8-hour daily exposure.

(1) These values have not been definitely established but are included to serve as a guide.

(2) Appears to be too low.

NOTE: ppm = Parts of substance per million parts of air by volume.

MG per cu meter = Milligrams of substance per cubic meter of air.

mppcf = Millions of particles of substance per cu ft of air.

per hour which run from 10 to 40, and very infrequently 60 or more air changes per hour. The ventilation rate expressed in air changes per hour is meaningless for process ventilation.

To be more specific, let us consider the minimum ventilation rate for the spray painting section of an automotive maintenance garage. Many plans which have come to my attention recently indicate that 20 to 30 air changes per hour are regarded as ample ventilation by many designing engineers. Since the painting section of the garage is usually a partitioned corner or end of the garage having a cubical content of about 4,500 cfm, and since the thinners for many lacquers, paints, and enamels have MAC's of 200 ppm or less, ventilation rates in the order of 7,500 cfm (100 air changes per hour) are needed to dilute the vapors adequately, if one assumes perfect dilution between the source of the contaminant release and the workers' breathing zone. Complete dilution is, however, seldom accomplished and correspondingly higher ventilation rates are needed to control the health hazard satisfactorily.

Estimating Requirements

To estimate the required process ventilation rate for solvents and other liquids equation (1) may be used, if the dilution between the source of contamination and the workers' breathing zone is complete. Since this is rarely the case, the computed rate must be increased accordingly.

$$Q = \frac{0.81 \times 10^6 \times S}{xy} \qquad (1)$$

Where Q = ventilation rate, cfm;
S = rate of solvent consumption, pounds per 8-hour day;
x = molecular weight of solvent; and
y = maximum allowable concentration of solvent.

A similar equation may be used for solid materials if the rate of dust or fume production is known:

$$Q = \frac{0.033 \times 10^6 \times S}{Y} \qquad (2)$$

Where Q = ventilation rate, cfm;
S = rate of dust or fume production, pounds per 8-hour day;
Y = maximum allowable concentration in mg per cu meter.

The approximate minimum general ventilation rates for several substances have been computed and are listed in Table 2 to indicate the high ventilation rates commonly required to obtain satisfactory industrial atmospheric sanitation by means of this method.

General ventilation is very useful and effective, as a rule, for controlling contaminants liberated or dispersed by scattered and minor sources as differentiated from specific and major sources. Effectiveness of general ventilation can be augmented a great deal by producing a high degree of circulation within the room. Spot blowing at or toward minor sources of contamination and away from the operators aid gen-

eral ventilation tremendously, since to be effective, the dilution of the contaminated air to a harmless level must be accomplished before it reaches the breathing zone of any worker. If good circulation is not accomplished within the room, an excessive ventilation rate will be required to control the exposures adequately, resulting in a very inefficient system and unnecesary heat loss in cold weather.

General Guide

No specific rules can be laid down for the type of general ventilation to be employed, that is, whether supply or exhaust. Each problem must be considered individually to obtain the best arrangement. However, the following considerations will serve as a guide in arriving at a satisfactory solution:

a—The exhausted air must be replaced, either by a supply system or by providing easy entrance for the make-up air;

b—Short circuiting of exhausted air must be prevented;

c—If a slight negative pressure exists within the space, cold drafts near doors and windows must be prevented;

d—Better dilution and lower operator exposure can be accomplished with proper supply than with exhaust since the supply air can be directed toward the important sources of contamination and good circulation is effected without accessory equipment;

e—A combined supply and exhaust system is preferred with a slight excess of exhaust, if there are adjoining occupied spaces; and a slight excess of supply is desired, if there are no adjoining occupied spaces;

f—Supply only will contaminate air of adjoining occupied spaces.

Local Exhaust Ventilation

Local exhaust systems are ventilating systems only insofar as they are the same in construction and involve air movement from buildings through fan and duct systems. Such systems are comparable to sewerage systems. Their primary purpose is to collect the contaminants in as concentrated form as possible and to convey them to the outside—not to produce ventilation. Generally speaking, the more efficient the local exhaust system, the less the volume of air moved and the less the ventilation rate. The transport medium in local exhaust systems is air, just as the transport medium for sewerage systems is water. The ventilation they produce is usually incidental. Here also a great deal of misunderstanding might be avoided if a suitable expression were coined to indicate more nearly the functional basis for such systems and to eliminate the direct reference to ventilation.

No matter what local exhaust systems are called, their design remains essentially a responsibility of the industrial engineer or the industrial ventilating engineer, just as the sewer pipe in your house is part of the overall plumbing system. The bases for designing local exhaust systems are different from those for ventilating systems and this fact must be recognized by everyone concerned, if we are to attain a satisfactory solution to the large and growing problem of industrial atmospheric sanitation.

Table 2 — Ventilation Rates For Dilution

Substance	Maximum Allowable Concentration	Quantity of Air in CFM Required to Dilute One Lb per Hr of Substance to Safe Level
Acetone	400 to 500 ppm	225 to 280
Benzol	50 to 100 ppm	850 to 1700
Carbon tetrachloride	50 to 100 ppm	425 to 850
Carbon disulfide	20 ppm	4250
Lead	0.15 mg per cu meter	1,790,000
Mercury	0.10 mg per cu meter	2,680,000
TNT	1.5 mg per cu meter	179,000
Silica	5 mppcf	45,600*

*Based on 30,000,000 particles per milligram.

It is not to be inferred, however, that local exhaust systems do not accomplish any ventilation. In some instances, such as foundry shake-out hoods or booths and spray paint booths, much ventilation is accomplished and the diluting effect of this ventilation must be taken into account in the design of the system if over-design is to be avoided. However, the primary function of the system is contaminant collection and removal, not ventilation.

Equations

It is not the purpose of this article to discuss the factors involved in the design of local exhaust systems. Suffice it to mention briefly the equations used to determine the volume of air needed for different types of local exhaust hoods to collect the contaminant satisfactorily.

For enclosing hoods:

$$Q = AV \quad (3)$$

Where Q = quantity of air in cfm;
A = area of hood opening in sq ft;
V = control velocity in linear fpm. Control velocity is the air velocity required at the point of escape of the contaminant into the atmosphere to accomplish a satisfactory capture.

For canopy type hoods:

$$Q = 1.4\ PDV \quad (4)$$

Where Q and V are the same as in (3);
P = perimeter of the hood in feet;
D = distance in feet from face of hood to point or area of contaminant release.

For slot type hoods:

$$Q = KWLV \quad (5)$$

Where Q and V are the same as in (3);
K is a constant varying from about 1.5 to about 6 depending upon the nature of the hood;

W = distance in feet from hood to most remote point of contaminant release;
L = length in feet of area (tank or table) over which contaminant is released.

For freely suspended small exhaust hoods:

$$Q = V(10x^2 + a) \quad \text{.....(6)}$$

Where Q and V are the same as in (3);
x = distance in feet from hood face to point of contaminant release;
a = area in square feet of hood opening.

Local exhaust systems are particularly suitable for controlling specific and major sources of contamination. They provide an effective, positive, and relatively foolproof means of accomplishing industrial atmospheric sanitation. They are more difficult to design than many other ventilating systems, but if properly designed are relatively inexpensive to install and operate. Local exhaust systems should be used wherever possible in preference to general ventilation systems, since they are more effective and result in lower heat loss.

Practical Pointers

A few practical pointers, precautions, or "do's and don'ts," may be in order to help avoid some common pitfalls recently observed by the author. This is by no means a complete list; many readers will think of others.

1. Design local exhaust systems carefully—calculate the total pressure loss, don't make an overall guess.

On a recent plan which came to my attention the fan specification called for a given volume at a total pressure of 7/8 in. water gage. The total pressure loss according to my calculations was nearly 2 1/2 in. water gage. If the specified fan had been purchased, the ventilation rate would have been much less than required and the system would have been wholly unsatisfactory.

2. Don't forget the make-up air and that it must be heated in cold weather. No exhaust system can function as intended if it is forced to draw air from a partial vacuum.

An example will illustrate what can happen if make-up air is ignored. Sections of airplanes were being spray painted in a corner of a large building which was used temporarily for airplane maintenance until a new building could be constructed. Since the temporary building was to be used only during warm weather it was planned to operate with doors and windows open to permit ready entrance of the air to be exhausted by five or six large propeller fans located in two adjacent walls forming one corner of the building which served for spray painting. Since the dust created by trucks and bulldozers at work on the nearby permanent building caused unsatisfactory paint jobs, all doors and windows were closed. As a result the building was under considerable suction, and air was found to be leaking into the room through two of the exhaust fans which were operated at lower speeds than the others. The spray mist and vapors at these locations were being carried over the painters rather than exhausted to the outside.

3. Always give due consideration to the contaminant you are handling.

Many dusts such as aluminum, flour, and TNT, and vapors such as alcohol, gasoline and acetone are flammable and explosive. Design the system with this in mind. A system which permits or results in a fire or explosion is even worse than one which does not produce satisfactory results.

4. Keep the heat loss in mind.

Where the volume of air exhausted is large, give careful consideration to supplying unheated make-up air to the exhaust zone at appropriate points.

An interesting installation which illustrates this point very well was brought to my attention recently. In a large cleaning and plating room the tanks were located against opposite walls of the room, with a wide aisle serving as a workway between the tanks. Slot type hoods, similar to those commonly used on tanks, were located along the front edges of the tanks, but these hoods were open to the outside by means of ducts located beneath the tanks and served as supply rather than as exhaust hoods. The exhaust hoods were located to the rear of and above the tanks and extended the entire length of the tanks. This arrangement accomplished (a) good control of the mists, (b) very little heat loss since most of the exhausted air was unheated, and (c) the "push-pull" type of ventilation at the tanks.

5. Remember that frequently in the eyes of the plant manager you are on trial when designing a system for his plant.

Give it "all you've got" to insure a satisfactory installation. It is much easier to keep him satisfied initially than to resell him after he has experienced a failure.

6. Keep in mind that the workers frequently object violently at first when an installation is placed in operation, since it may interfere with their established routine and sometimes requires a change in the conduct of their work.

It seems to be human to oppose change. However, if your job is well done it will not be long until the worker becomes your strongest supporter. For example, not long ago I was present when a trial local exhaust system was placed in operation. Strenuous objection was voiced by the nearby workers. Several months later the system was shut down for several days so that the collector could be tested in another trial local exhaust system at a different operation in another building. Not long after the system was shut down the affected workers threatened to strike if the local exhaust system were not put back into operation without delay.

7. Don't overlook natural drafts or air disturbances, particularly in the design of local exhaust systems.

The air flow pattern into a local exhaust hood near an open door or window will be completely upset on windy days. Unit heaters, if directed across the exhaust zone of a local exhaust hood, will interfere with or completely nullify the effectiveness of the hood. Rapid movement of large objects in or near the exhaust zone will also disturb the air flow pattern into the hood.

Drainage Disposal from Air Conditioning Systems

T. W. REYNOLDS

A few things to think about when arranging for drainage from air conditioners – the law, grading, silt, sizing – are taken up in this practical discussion.

DISPOSAL of water from an air conditioning system is sometimes a problem, for disposal must be made without any direct contact between the air conditioning system and the sanitary sewer. If the flow is just a mere drip from a cooling coil, it is usually taken care of by a drip pan below the coil with the pan drained by a small pipe to spill over a floor drain outside the air conditioning chamber. The drains may even be in the air chambers, providing they go to a sump ejector and then through a check valve to the sewer beyond the house trap. This is usually done in the more extensive air conditioning systems.

Now suppose that the air conditioning drain is in a locality somewhere in Long Island where the municipal inspector reads you the local regulation that no water from an air conditioning system may enter the municipal sewers and he interprets this to mean even the grains of condensation from a cooling coil. This amount of water is too small to cause any overloading of the local sewers, but laws are laws. What can one do!

In such cases the slotted drain pipe, Fig. 1, will leach off the water in sandy soil, and in other soil where the quantity of water passed is not too great, and the pipe is surrounded by broken rock in dry soil. This method will of course increase the quantity of ground water and is therefore theoretically helpful in a locality where too much well water is being used. This method is also helpful in the drainage of underground air conditioning ducts.

It is difficult to believe that anyone would connect a floor drain to a sanitary sewer and then place that floor drain in an air conditioning chamber or underground air conditioning duct. However, such an installation is sometimes thoughtlessly done. There is not enough water to maintain a seal in the trap of such a drain, especially so with evaporation of the moisture due to the great quantity of air passing through the duct. Even if the seal were maintained, it would still be a violation of all sanitary laws.

Fig. 2 shows an air conditioning drain which presents yet another drainage problem. The plan worked well for the first year or two, but thereafter delivered its water at intervals above ground between the points *B-C* with fountain-like display. The party who placed this drain was located and he offered the following explanation.

To curry favor with the adjacent property owner he avoided any easement which would cut up this owner's property, such as by the line shown dotted in the sketch. Instead he used a lot of material and labor to do a very poor job, but one which he figured would work out all right. Now by the time he progressed to near *A*, even after laying a level stretch close to the property line, he still had to make a slight rise to enter the main sewer. Nothing daunted, he made the connection, filled

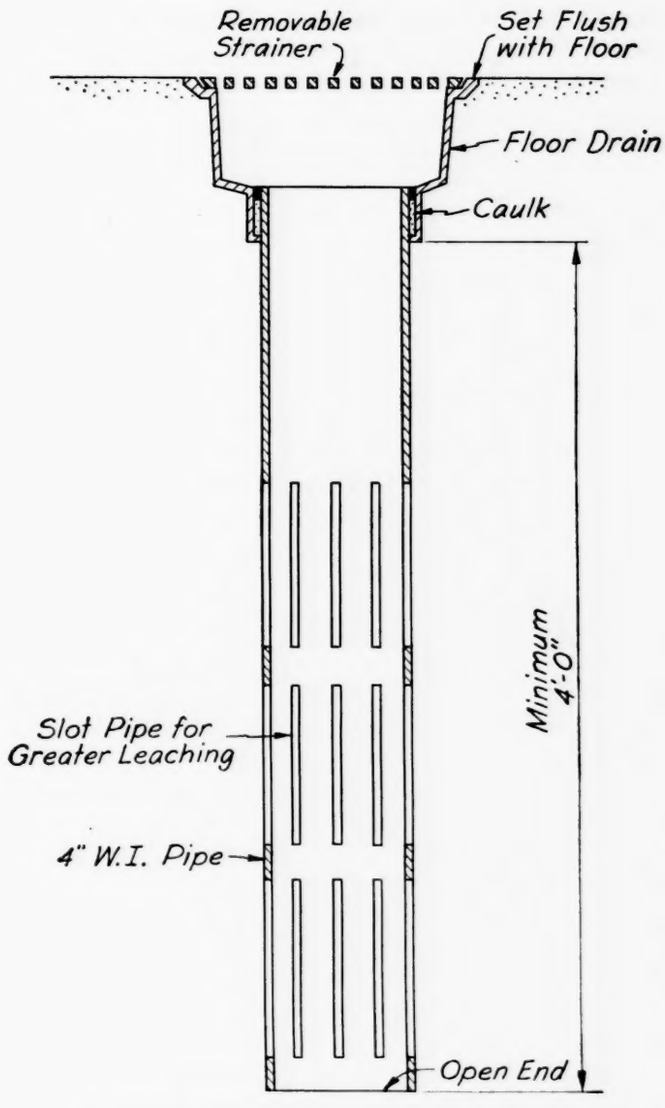


Fig. 1. Detail of leaching floor drain for air conditioning systems. Pipe sunk in dry soil.

in the trench, covered the evidence, and departed. He reasoned that he had purposely made the line oversize and if this were not enough to overcome the difficulties due to insufficient grade and a pocket, he could still rely on the static pressure of the drainage (reduced by

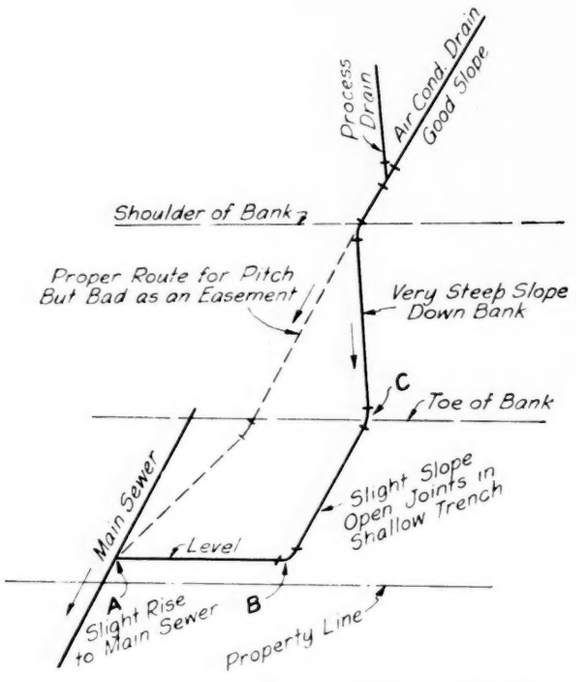


Fig. 2. Why air conditioning drainage lines fail even when oversize. Silt fills the level portions.

a very high bank) to flush the line, and all would be well. What he did not consider was the silt deposits from a process drain. This silt never did flush out, but rather settled out, until in time the bore of the level stretch of the drain was completely filled with silt.

After this took place, water backed up in the drain along *B-C* and continued up the bank until the static head broke a tile in *B-C* and relieved the pressure by leakage into and over the ground. Although frequent repair was made, in time silt was deposited from *B* to *C*, so that this portion of the line was full of water. This water, plus its shallow depth, caused the drain to freeze up in late winter. With the spring thaws more of the tile would break, because the bore of the drain was completely filled with ice. After the tiles broke there was always a pond in the immediate vicinity.

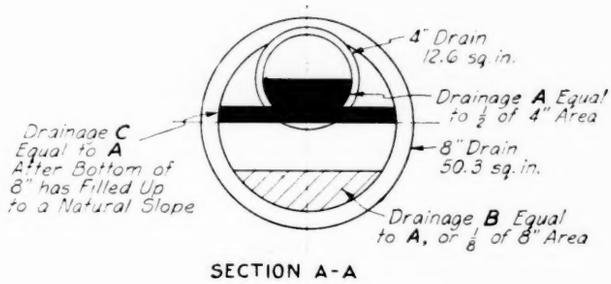
Lacking the proper easement, available material and labor, the tile drain *B-C* was then relaid in an unorthodox manner with open joints. Cold contacting rocks were removed, but those just below the drain were left, and the trench was backfilled with warmer material such as tree branches and other rubbish. Although this was all done some time back, there is still no evidence of water above ground, as both the silt and water now have many means of exit and many voids for temporary storage of water while percolating through the ground.

In the repair of the drain, search was made as usual for the much claimed interference of tree roots, but none were found entering the joints. A drain which only runs water occasionally, and has good pitch and area so that water is not stagnant, and also has good cemented joints, is not as conducive to tree root growth as one is led to believe. What does happen and was so found at two points in the line where the slope was good, was a tree root which in its normal travel longitudinally encountered the interfering pipe, passed up over it and down again. Now in time as the root grew larger and partially encircled the pipe, enough pressure was developed until it crushed the pipe. Another such root passed over in the same way, but rather close to the spigot end of a tile where the leverage on the length finally was enough to crack open the joint by depressing the tile at the spigot end.

A claim sometimes made where available grade is less than recommended practice, is that where the pipe is oversize, it will have a hydraulic slope within itself. Such reasoning was carried out on another job. Here only a 4 in. drain was required, but an 8 in. drain was substituted. It was laid practically level as its additional size used up the slight difference in elevation between the start and end of its run.

The fallacy of this reasoning is shown in Fig. 3. Assume the 4 in. pipe to be half full of water as *A*, then the same flow of water in the 8 in. would occupy only one-eighth the area of the 8 in. as *B*. The 4 in. would have 6.3 in. or 50% of its perimeter dry, whereas the 8 in. would have an unwashed perimeter of about 17.5 in. or 70%.

Due to lack of proper grade, the 8 in. pipe will finally fill up with deposits to at least the slope of the 4 in. (unless the water happens to be free of all silt). At the point mentioned, the comparative areas and unwashed perimeters will then be only two to one, but most likely the 8 in. pipe will continue to collect material, due to unevenness of deposits over which the sluggish rate of flow travels. In time the line may become completely filled. In the final analysis, if both pipes are assumed to be clean and running full, with the slope per 100 ft about ½ in. for the 8 in. drain and 4 in. for the 4 in. drain, then the gallons per minute of flow will be substantially the same in each. What then is the advantage of the expensive 8 in. drain?


4" Drain
12.6 sq. in.
Drainage A Equal to ½ of 4" Area
Drainage C Equal to A After Bottom of 8" has Filled Up to a Natural Slope
8" Drain
50.3 sq. in.
Drainage B Equal to A, or 1/8 of 8" Area

SECTION A-A

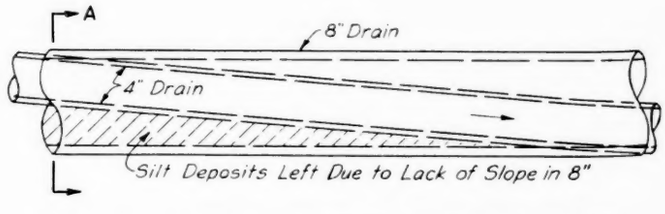


Fig. 3. Comparative drainage of 8 in. drain laid level and 4 in. drain that is pitched 4 in. for equal distance.

Industrial Dust Explosions

HYLTON R. BROWN

Engineer, Bureau of Mines, College Park, Md.

New problems in dust control are discussed in Bureau of Mines Information Circular 7309 abstracted on these pages for ventilating engineers.

EXAMINATION of lists of manufacturers shows that there are in the United States approximately 28,000 plants where dust-explosion hazards may exist. At one time, only carbonaceous dusts, such as coal, grain, starch, sugar, and wood dusts, were considered capable of forming explosive mixtures with air, but recent laboratory tests have shown that many of the metal powders, such as zirconium, magnesium, aluminum, and titanium, are more hazardous than the carbonaceous dusts. Tests with samples of powdered materials used in the plastics industry indicate that many of them are only slightly less hazardous than the most explosive metal powders. The former general rule that dust-explosion hazards existed only where combustible material was produced in finely divided form must be revised to meet present conditions and to agree with the results of laboratory research. It now appears that the hazard exists whenever material that will burn or oxidize readily is reduced to powder form and wherever dust is produced or handled in connection with the manufacture or processing of such finely divided materials.

In the calendar year 1943, 41 dust explosions were reported in which 13 persons were killed, 44 injured, and the property loss exceeded $9,000,000. These explosions occurred in metal-powder plants, grain elevators, woodworking plants, flour mills, starch factories, feed and cereal mills, cotton mills, a furfural plant, and several establishments handling miscellaneous products.

Conditions Under Which Explosions Occur

The requisites for a dust explosion are (1) a cloud of dust in suspension in air within certain limits of concentration and (2) a source of ignition of sufficient intensity to start combustion. In all industrial plants handling finely divided material, there are many possible combinations of circumstances that may produce the conditions necessary for an explosion, and in the minds of many explosion investigators the question is not "Why do dust explosions occur?" but "Why do we not have more dust explosions?"

Many explosions start in or around grinding machinery. The process is essentially one that produces dust or fine particles either as the desired product or as a byproduct, and there are numerous possible sources of ignition. Foreign material, such as nails, bolts, or stones, may enter the grinder with the feed and produce sparks, or the metals may be heated by friction or impact within the grinder until it reaches a temperature capable of igniting the dust.

Other dust explosions occur in bolting, sifting, or screening operations. Dust clouds are normally produced in such equipment, and static sparks are frequently believed or assumed to be the cause of the dust ignition.

Conveyors and conveying equipment may create dust clouds either during normal operation or when they are overloaded or break down. Frictional heat or sparks produced by impact of moving metallic parts may then be responsible for dust ignitions.

Mixing and blending operations generally produce dust clouds, and static or metallic sparks are believed to have been responsible for their ignition.

In driers or kilns, dust clouds are frequently formed during normal operation. This is particularly true of spray driers in which explosive concentrations of the fine dried material may be present at the beginning, end, or for prolonged periods of

each run. The source of heat for the drier may be the source of ignition for the dust cloud.

Saws, cutters, shapers, and sanding machines may create explosive dust clouds, and there is always the possibility of ignition by sparks or heat produced in such operations.

Heavy concentrations of dust are sometimes handled through suction hoods and air lines, and research has established the fact that high-voltage charges of static electricity may be formed on the ducts or on the dust particles. If proper grounds are not provided, sparks produced by the accumulated charges may ignite the dust in suspension in the ducts or in the collector.

Laboratory Experiments

Equipment has been developed with which it is possible to determine the ignition temperature, the relative inflammability, the ease of ignition, the limits of explosive concentration, and the pressure produced following ignition of dust clouds of different concentrations. In connection with these experiments, information has been obtained on the effect of particle size and shape, uniformity of size and distribution of the dust particles, moisture content, percentage of volatile matter and ash, and rate of oxidation.

It is not possible at this time to discuss in detail the behavior of all types of dusts in laboratory experiments. A few general statements can be made that will indicate the effect of certain factors upon the explosibility of some dusts and permit certain group classifications that will indicate the relative explosion hazards in plants handling such products.

Carbonaceous Dusts

Coal dust can be cited as an example of the group of carbonaceous dusts that have been tested in the laboratory to determine their relative inflammability, and some of the following pertinent data for 200-mesh Pittsburgh coal dust will be of interest:

Ignition temperature of dust cloud, 1130F.
Relative inflammability, 90 +.
Minimum energy required for ignition of dust cloud, 0.04 joule.
Minimum explosive concentration, 0.055 oz per cu ft
Maximum pressure at 0.5 oz per cu ft, 46 lb per sq in.
Maximum rate of pressure rise, 780 lb per sq in. per sec

In these laboratory tests, 200-mesh material is used both in experimentation and demonstration to permit direct comparison of test results obtained with dusts of different types. Previous experiments have shown that 8-mesh material is too coarse to enter into the inflammation or explosive reaction. The 20-mesh fraction of coal dust does not ignite and propagate flame readily but appears to be capable of contributing to an explosion if it is initiated in finer dust. Flame propagation and high pressures are obtained in tests with 30- to 200-mesh dust.

More than 130 carbonaceous dusts have been tested and classified according to their explosibility. This group includes coal, virtually all of the grain dusts, such as corn, wheat, oat, barley, and rye dust, and the products of milling, such as flour, feed, meal, starch, and malt. Other examples of carbonaceous dust tested and classified are wood flour, powdered milk, spices, tobacco dust, powdered sugar, cocoa, drugs, leather dust, and certain insecticides. The maximum rate of pressure rise that indicates the severity of the explosion hazard ranges from low to high for dusts in this group. Grain dust is considered to have a low rate of pressure rise—200 lb per sq in. per sec. Coal dust has a medium rate of pressure rise—780 lb per sq in. per sec—and cornstarch has a high rate of pressure rise—1,590 lb per sq in. per sec.

Metal Powders

Magnesium powder is a good example of the group of metal powders that have been found capable of forming explosive dust clouds in air. Laboratory tests have provided some important data on the explosive properties of this powder:

Ignition temperature of dust cloud, 968F.
Relative inflammability, 90 +.
Minimum energy required for ignition of dust cloud, 0.02 joule.
Minimum explosive concentration, 0.020 oz per cu ft
Maximum pressure at 0.5 oz per cu ft, 72 lb per sq in.
Maximum rate of pressure rise, 4,760 lb per sq in. per sec

More than 50 samples of metals and alloys have been tested in the laboratory and classified according to their relative inflammability. This group includes aluminum, antimony, iron, lead, magnesium, tin, titanium, zirconium, and alloys or mixtures of these or other metals among the 30 or more now available in powdered form. Ignitions and explosions of metal powders may occur under the same conditions required to produce explosions of carbonaceous dusts, and, like the first group, the maximum rate of pressure rise for the metal powders ranges from low to high. Lead powder is one of the group that presents virtually no dust-explosion hazard. Although lead dust clouds can be ignited at 1076F and the relative inflammability is 20, the maximum pressure produced is only 2 lb per sq in., and the maximum rate of pressure rise is only 50 lb per sq in. per sec. Tin can be classified in the group that presents a moderate or medium explosion hazard, because it produces a maximum rate of pressure rise of 850 lb per sq in. per sec. In the group that presents a high or serious explosion hazard, there are several outstanding examples of aluminum, magnesium, and zirconium. A sample of aluminum produced the highest rate of pressure rise measured in this series of tests—5,700

lb per sq in. per sec. Zirconium is included in the particularly hazardous group because it has a maximum rate of pressure rise of 2,570 lb per sq in. per sec and because of its ease of ignition. A number of ignitions were obtained at room temperature without any outside source of heat or flame when a quantity of the finely divided powder was blown into the air. Ignitions are believed to be due to static electricity on the dust particles.

Plastic Powders

Some of the phenolic-type resins can be used to illustrate the hazard of dust explosions in plants manufacturing or using plastics in powdered form. Laboratory tests with a sample of phenolic resin produced the following results:

Ignition temperature of dust cloud, 932F.

Relative inflammability, 90 +.

Minimum energy required for ignition of dust cloud, 0.01 joule.

Minimum explosive concentration, 0.025 oz per cu ft

Maximum pressure at 0.5 oz per cu ft, 61 lb per sq in.

Maximum rate of pressure rise, 3,160 lb per sq in. per sec

More than 50 samples of synthetic resins and powders used in the plastic industry have been tested in the laboratory and classified according to their relative explosibility. The group includes phenolic, urea, vinyl and other types of resins and a number of molding compounds, primary ingredients, and fillers. Many of these powders were found to present a greater dust-explosion hazard than the common carbonaceous dusts. The plastic powders, like the carbonaceous and metallic dusts, can be grouped to indicate their explosibility, depending on whether the rate at which pressure is produced following ignition is low, medium, or high. Some of the resins have comparatively low rates of pressure rise (less than 500 lb per sq in. per sec) and others, principally the urea resins, have rates of pressure rise below 1,000 lb per sq in. per sec, which permits them to be placed in the medium class. Many of the samples tested had maximum rates of pressure rise exceeding 2,000 lb per sq in. per sec and the great majority of the powders used in the plastic industry must necessarily be considered in the high-hazard group.

Dust-Explosion Prevention and Protection

Although many of the dusts mentioned have different explosive characteristics, the fundamental principles for explosion prevention are essentially the same. It is necessary to prevent, if possible, the formation of dust clouds and to eliminate all sources of ignition. Good housekeeping is always recommended, because it is desirable to prevent any dust accumulations where they could be thrown into suspension to form explosive mixtures with air. Dust-collecting equipment designed and installed by specialists in this line of work will do much to reduce the dust-explosion hazard. An efficient system usually consists of suction hoods designed to collect the dust at points of dissemination, air lines or ducts to convey the dust away from working areas by the most direct route, and filters or collectors designed to trap and remove the dust from the air. Fans or blowers are necessary to create the desired suction, and both the volume of air to be handled and the velocity of the air at the hoods and in the conveying lines must be controlled carefully to insure satisfactory performance of the system.

Several times recently, the use of flame cutting and welding equipment has been reported as the cause of dust ignitions. The use of open flames or heating devices capable of raising the dust to its ignition point should be prohibited wherever dust-producing machinery is in operation. Necessary repairs that require the use of flames or heat should be made only when equipment is idle and all dust has been removed from the area where the work is to be done.

Devices

Special electrical equipment has been designed for dusty industries, and no lights, fixtures, switches, or wiring not approved for such use should be installed where any dust-explosion hazard exists.

Any charges of static electricity detected on machinery should be removed by means of ground wires, brushes, or combs. Charges of static electricity are particularly dangerous where sparks may ignite dust clouds.

In certain instances devices can be employed to vent or dispel the pressure built up in a dust explosion and thus prevent serious damage to equipment or the building housing it. The adoption of such protective measures should not be made the excuse for neglecting well-recognized standards for preventing dust ignitions. Vents in the form of light, frangible disks on equipment, hinged windows, or panels in building walls, skylights and special ventilators may be used for protection against dust explosions, but to be effective it is necessary to maintain the proper ratio between vent area and volume to be vented. Information on this ratio is not available for all dusts or all types of equipment. As a general rule, 1 sq ft of vent area should be provided for each 80 cu ft of volume, if the explosion to be vented is of the type that has a low rate of pressure rise. Where the dust being produced or handled is capable of producing an explosion with a medium rate of pressure rise, the ratio should be 1 sq ft of vent to 40 or 50 cu ft of volume; and where the rate of pressure rise is high, the maximum possible venting area should be provided. It is generally possible, by providing a weak wall or roof, to obtain a venting area of 1 sq ft for each 15 or 20 cu ft of volume.

Resistance Welding of Sheet Metal

R. T. GILLETTE[1]
Works Laboratory, General Electric Co., Schenectady, N. Y.

As a method of fabricating the large amount of sheet metal ducts and forms in the ventilating industry, this article calls attention to resistance welding. Tools and new techniques are described.

RESISTANCE welding offers a fast, low-cost method of fabricating sheet metal and may be used either in shop fabrication or on location where shop service in the form of electrical power, compressed air, and water are available. It may be used for welding structures composed of combinations of light-weight structural angles, sheet metal, expanded metal, screen, galvanized sheet, tin plate, terne plate, stainless steel, brass, bronze, and aluminum both in like and dissimilar metal combinations. These metals may be welded in almost any combination with the exception of aluminum, which should be welded only to aluminum.

Resistance welding is also desirable in many cases for welding various threaded or plain studs, nuts, bolts, or other types of fastening devices, as well as hinges, locks, latches, and handles to various structures.

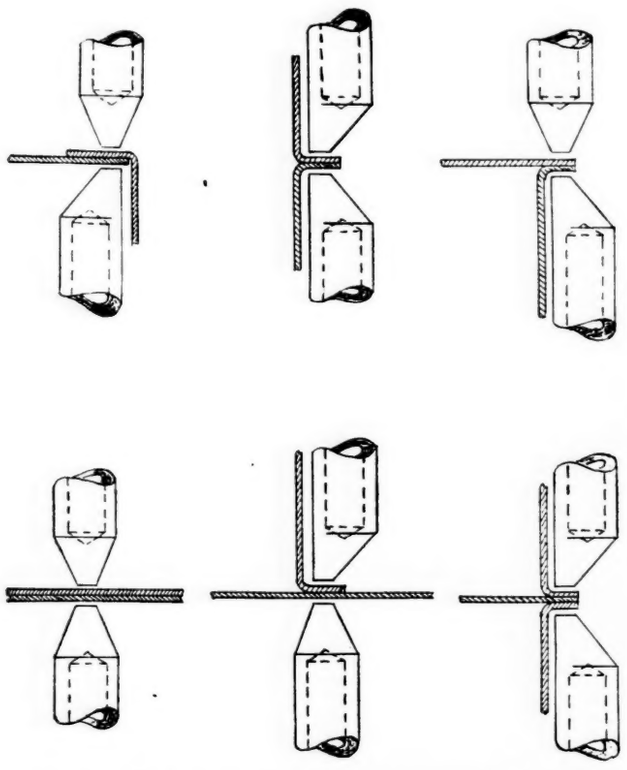


Fig. 1. Side elevation of spot or seam welded joints, made with standard welding points or wheels.

[1]See "Getting Personal," page 104.

To successfully resistance-weld various structures, such as ducts, pipes, panels, trays, and grills, attention should be given to properly designed joints for welding, since parts designed for riveting, lock seaming, soldering, or other methods of fabrication may not have the type of joints most desirable for welding. The types of joints shown in Fig. 1 are typical of the ones successfully used in resistance welding. A sufficient amount of overlap should be allowed so that spot-welding electrodes or seam-welding wheels will contact the joint with sufficient extra material to confine the hot metal so that there will be no expulsion of the metal.*

What happens when an attempt is made to make

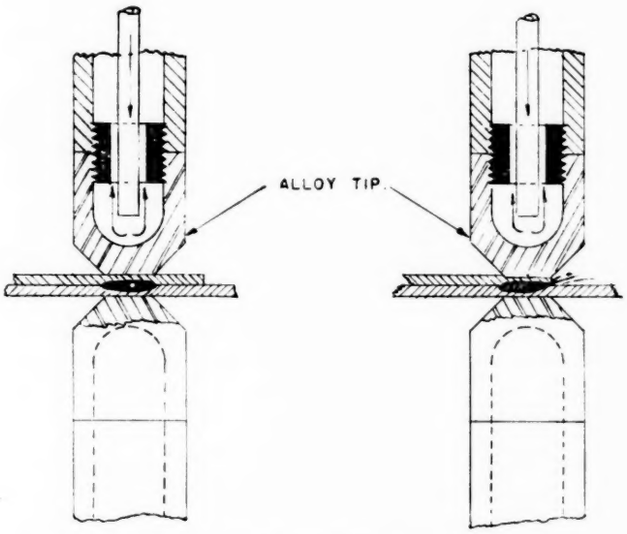


Fig. 2. When welds are made near the edge.

welds too near the edge is shown schematically in Fig. 2. Hot metal is expelled, which leaves voids, causes weak welds that lead to structural failures. Equipment used for spot-welding may also be employed for projection-welding various types of attachments, like small reinforcements and various fastening devices. The projections localize the current instead of spot-welding tips of reduced area.

Correct and incorrect shapes for projections in sheet metal are shown in Fig 3, as are also the correct and incorrect annular projections for round nuts or reinforcements, and elongated projections of particular value for welding to curved surfaces.

Fig. 4 shows an edge projection weld and the typical cross section wire weld. Fig. 5 illustrates types of screws and studs prepared for projection

*A pamphlet published by American Welding Society, entitled "Recommended Practice for Spot and Seam Welding of Low Carbon Steel," tabulates this information.

welding. It is possible to purchase, directly from several manufacturers, many different nuts, bolts, screws, hinges, and latches, already prepared with projections suitable for welding, or many standard parts may be spot-welded without special preparation.

The selection of proper welding equipment for welding in the heating and ventilating industry is of the utmost importance, if long trouble-free production is desired.

The equipment should be power-operated either through motor operation with an air cushion pressure device or direct air operation. Manually-operated equipment is not satisfactory, since consistent operation is not possible. Where mechanical strength only is required on material not thicker than 16 gauge, the rocker arm type of machine, either motor driven or air-operated, Fig. 6, rated 75 kva, and capable of delivering about 32,000 amperes, is about the most inexpensive type of welder that is practical. This welder, however, is not adaptable to projection welding.

Table 1 — Spot-Welding Procedure

Tin Plated Steel

Thickness of Material, In.	Time in Cycles (60 cycle power)	Current, Amperes	Electrode Force or Pressure Exerted on Work, Lb	Strength, Pounds in Shear
.016	5	8200	200	350
.020	6	11200	300	550
.031	13	6500	300	720
.041	13	9500	500	870

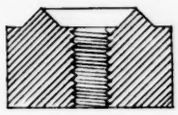
Seam Welding Procedure for Galvanized Steel

Thickness of Material, In.	Time in Cycles On	Time in Cycles Off	Current, Amperes	Electrode Force or Pressure Exerted on Work, Lb	Speed, In. per Min.	Hydrostatic Test, Lb
.040	8	2	22000	1000	30	600
.062	10	3	26000	1200	30	1200

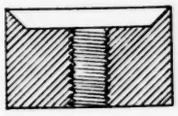
The press type spot-projection welder, rated 150 kva and capable of delivering about 50,000 to 60,000 amperes, is the most universal machine. It can be used for both spot and projection welding and can successfully weld up to two pieces of 3/16 in. steel or one piece of 3/16 in. steel to heavier material. Of course, press type welders of any capacity below this are available where light work only is to be welded. Where pressure-tight welds are required, a seam welder is necessary. A universal seam welder as in Fig. 7 is capable of welding both circumferential and longitudinal seams by swinging in the proper lower arm and rotating the upper wheel carrying bracket. This type welder with a 30 in. throat and 150 kva rating will weld up to two pieces of 16-gauge material and make pressure-tight seams, with the proper type of control. It is also particularly adaptable to making long straight rows of spot welds, as in Fig. 8, that may be spaced equally at any predetermined spacing. Gun or portable welders are also available which may be used for final assembly on parts too large to be handled on the standard welding machines. Since these welders are highly special and should be designed for the job they are to perform, recommendations of the makers of such equipment should be requested.

SECTION THROUGH CORRECT PROJECTION

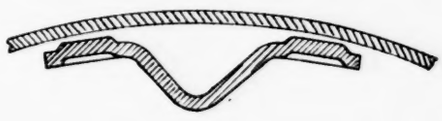
SECTION THROUGH INCORRECT PROJECTION

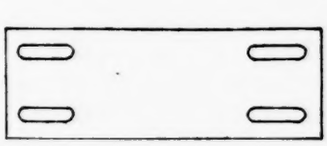


CORRECT PROJECTION



INCORRECT PROJECTION





PROJECTIONS FOR CURVED SURFACES

Fig. 3. Correct and incorrect methods of making metal projections for usual projection welding jobs.

When purchasing either spot or seam welding machines, the shortest throat that can be used should be specified, and the rating should be in secondary welding current delivered at the welding points or wheels, rather than kva. Welding machines with excessively long throats have low power factor and high primary current demand. Ratings in kva given previously are for 24 in. throat. For deeper throat, the kva rating would be increased but current delivered would remain the same.

Both spot and seam welders should be equipped

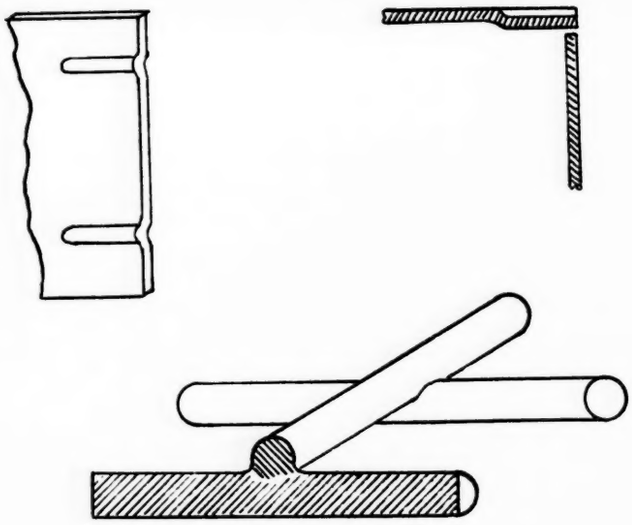


Fig. 4. Projections for corner and cross-wire welds.

with fully synchronous electronic controls. The same type of control may be used on all types of machines. They should include the feature of pulsation welding for spot welders, which also gives the interrupter feature for seam welding. Use of phase-control for heat regulation as an auxiliary to the series-multiple connections, or a tapped transformer, gives closer heat regulation than tapped transformer only. The control can be mounted near the machine or it can be attached to it, thus making a complete unit which can be moved from place to place with the minimum amount of wiring or piping to be done in the field. Where cooling water is unavailable, an enclosed water circulating system with radiator may be installed. Where compressed air is unavailable, spot welders with straight mechanical spring pressure can be built, although they are not nearly as flexible as the air-operated machines. While standard welding machines are very flexible, it is sometimes possible to get 5 to 20 times the production on a given job by using specially built resistance welding machines. Manufacturers of welding machines have many helpful suggestions for the guidance of individuals starting a welding program, and these manufacturers will engineer and build a complete installation, specify proper control, and help start the machines.

For actual techniques of welding, the data of Table 1 will be helpful in setting up the machine for welding several different thicknesses of sheet metal.

The American Welding Society pamphlet, previously mentioned, gives a welding schedule for spot and seam welding low carbon steel.

These tabulations should be used only as a start and should be modified slightly to suit the conditions of the job at hand. Welding of any of the metals mentioned is not confined to two pieces, for three or more pieces may be welded simultaneously. Long lengths of round duct or pipe may be made on a seam welder by welding the longitudinal seams, first

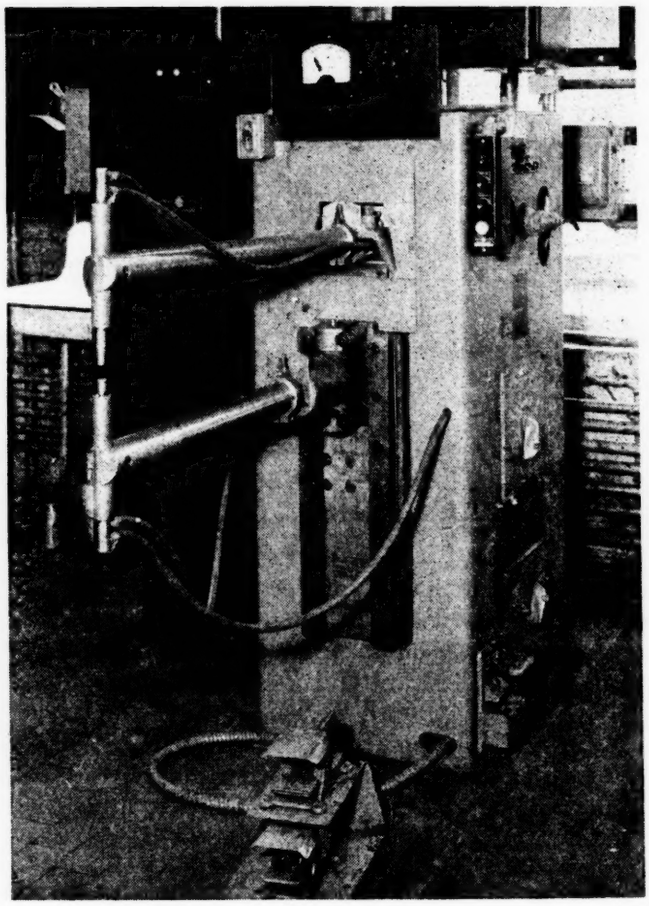


Fig. 6. A 75 kva spot welder.

in lengths that can be handled in the seam welder, then adding lengths and seam welding the circumferential seams and pushing back the long pieces on rollers.

When welding any of the plated materials, a certain amount of the plating material will alloy with and adhere to the welding wheels or electrodes. This will have to be removed frequently or the seam-welding wheels or spot-welding electrodes will stick to the work and cause burning. The preferred method is to change electrodes and recondition them in a lathe. The use of the so-called knurl drive on seam welders tends to remove this coating partially

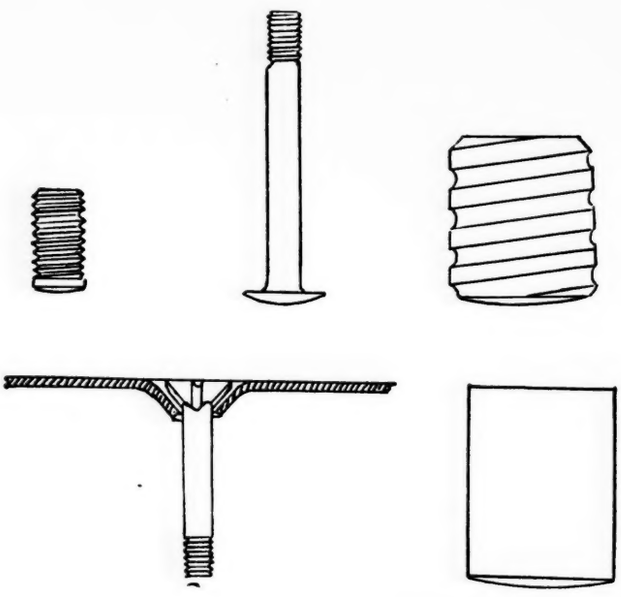


Fig. 5. Studs and screws for projection welding.

and make reconditioning less frequent. The use of an ammeter to measure current makes the original set-up of a job easier, and if records are kept of the various factors used to make a weld, it expedites a subsequent set-up on the same job.

Material for welding should be clean and free from oil, scale, oxide, and dirt.

The use of various jigs, fixtures, and locating devices will greatly increase the production of welding operations. Since these fixtures should be kept as light as possible, the use of aluminum or insulating materials for fixtures should be encouraged. Employment of any magnetic material for fixtures should be kept to a minimum, since they will run hot because of induced currents and thus reduce the capacity of the welder. Any part of the fixture that has to carry current should be made of one of the copper alloy electrode materials.

When welding many of the threaded studs, screws, bolts, and similar parts, the chucking fixture shown

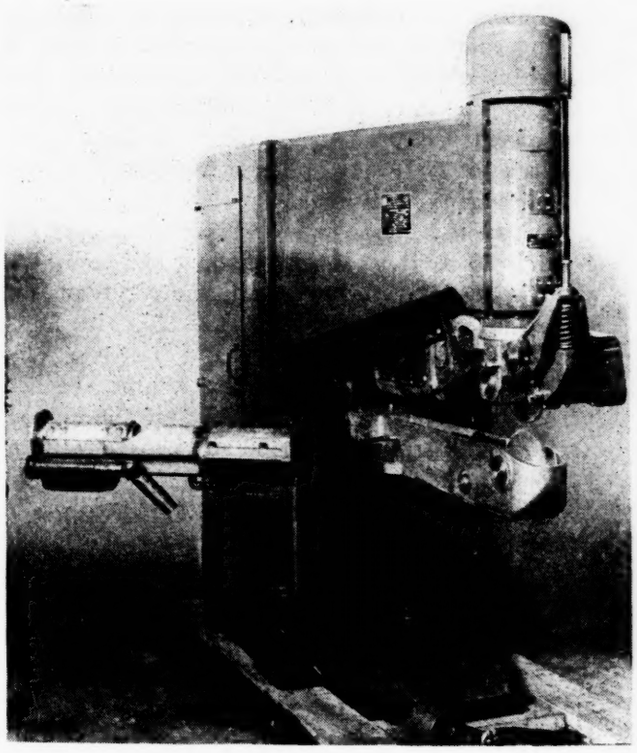


Fig. 7. Universal seam welder.

in Fig. 9 is very advantageous. The body of the fixture is common to all sizes but a collet has to be made for each size stud or screw. About 1/16 in. of the screw or stud should extend above the surface of the collet to weld to the part. The welding pressure contracts the collet and clamps the part. The air connection on the side of the fixture releases the collet after the weld is completed so the screw may be pulled out.

The use of this clamping fixture is necessary on all long, rather small diameter parts since they cannot carry sufficient current to make a weld and not melt and collapse in the center.

It should be obvious, then, that if we are to expect a consistently good quality of welded product we

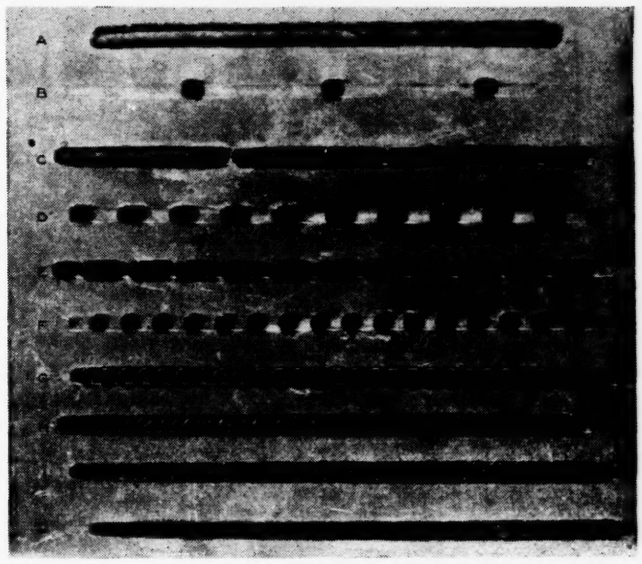


Fig. 8. Resistance welds made at approximately 7 fpm by line welder. A—21 spots per in. B—long off-period, short on-period. C—short off-period, long on-period. D—intermediate speed and ratio. E—intermediate speed and ratio. F—1-2/3 spots per in. G—3 spots per in. H—4½ spots per in. I—6 spots per in. J—15 spots per in.

should have parts properly designed for welding, modern welding machines and controls, clean material, power supply to the welding machine of sufficient capacity so not more than 10% voltage variation will be experienced, clean air and water, and trained welding machine operators.

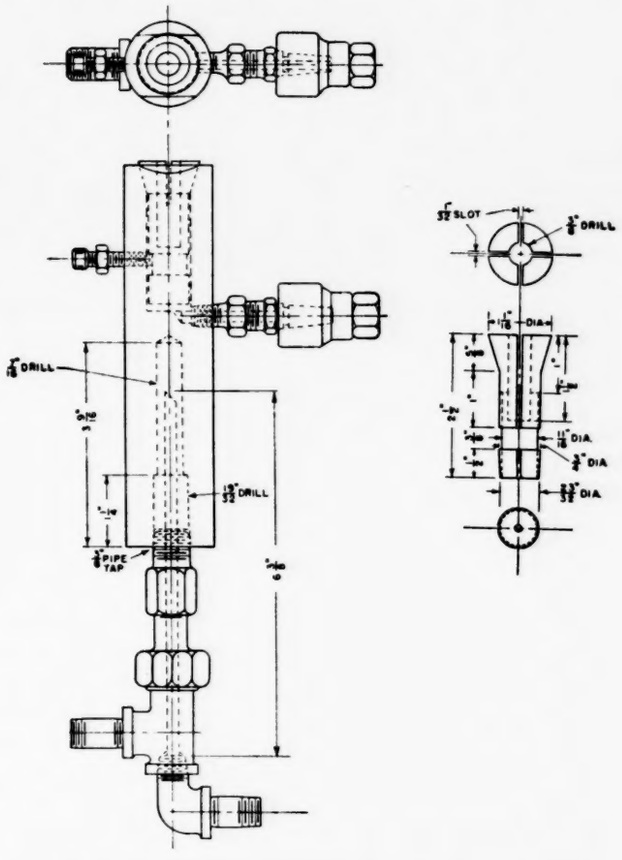


Fig. 9. Chucking fixture for welding threaded studs, screws, bolts, and similar hard-to-handle fixtures.

A Single Equation Design Procedure for Radiant Heating Systems

PORTIONS of calculations for radiant heating systems have been largely done, up to the present, by use of certain rule-of-thumb methods, experience data, or assumptions. This has been true of the determination of the heat output of the panel necessary to balance the heat loss.

A rational method for this step in computations was developed some years ago by Professors B. F. Raber and Francis W. Hutchinson of the University of California, and described in an ASHVE paper in 1941. Unfortunately, this rational method involved the simultaneous solution of seven equations, a complicated procedure.

This rational solution has, however, recently been simplified by Professor Hutchinson, now of Purdue University, in a paper entitled "Single-Equation Design Procedure for Radiant Panel Systems," presented before the 52nd annual meeting of the American Society of Heating and Ventilating Engineers in January, 1946, a summary of which follows.

Only one equation need be solved to determine if the proposed panel condition and structural design are compatible.

A new idea has been introduced by the author in use of an "equivalent heat transmission coefficient." This equivalent U value is a single U which would represent the heat lost by the various enclosing surfaces if they were all of a homogeneous material with the same air temperatures on both sides. Expressed in another way, the equivalent U is the average of all U values *for unheated enclosing surfaces* weighted according to area and temperature difference. Expressed in equation form, when U_e is the equivalent coefficient, A the area in square feet, t the temperature difference between the room air and the air on the opposite side of the surface, and the subscripts i, g, f, c, and w represent inside unheated wall, outside glass, unheated floor, unheated ceiling and outside wall areas, respectively, then

$$U_e = \frac{U_i t_i A_i + U_g t_g A_g + U_f t_f A_f + U_c t_c A_c + U_w t_w A_w}{t_i A_i + t_g A_g + t_f A_f + t_c A_c + t_w A_w}$$

The single equation proposed by Prof. Hutchinson is as follows:

$$C = \frac{0.018V(K_1K_4 - t_oK_4 - vK_3) + (K_4K_5 - K_3K_6)}{v[0.018V(vt_o - K_1 + t_o) + (t_oK_6 - K_5)]}$$

where C = the equivalent conductance of all the unheated enclosing surfaces of the room, in Btu per hr per sq ft per F;

V = outside ventilation air, in cubic feet per hour, passing each square foot of inside surface;

v = fraction of total enclosure surface which is unheated;

t_o = outside design air temperature; and K_1 to K_6 have values as follows:

$K_1 = 140 - ut_p$

$K_2 = 1 + v$

$K_3 = 0.7\,vK_1 + 1.08\,ut_p$

$K_4 = 0.7\,vK_2 + 1.08\,u$

$K_5 = 0.7\,vK_1 + 0.4\,u\,(K_1 - t_p)$

$K_6 = 0.7\,vK_2 + 0.4\,uv$

and where

t_p = temperature of the heated surface or panel, F; and

u = fraction of total enclosure surface which is heated, or $u = 1 - v$

As an example of the use of the equivalent coefficient conception and the single equation just given, the following example (a portion of which appeared in Prof. Hutchinson's paper) is included. Assume the following:

Example. A room 20 × 20 ft in plan, 10 ft high, is to have a radiant panel ceiling with a surface temperature of 100F (t_p) when it is 0F outside, and with one air change per hour.

This room has one outside wall, with a U of 0.30 containing 20 sq ft of single window ($U = 1.1$), a floor with a U of 0.35 below which the air temperature is 60F, and three inside walls, $U = .20$, with 60F air on the other side.

Solution. As a first step, determine the areas involved to find u and v. The area of the heated panel (ceiling) is $20 \times 20 = 400$ sq ft. The total area of enclosing surfaces is $2\,(20 \times 20) + 4\,(20 \times 10) = 1600$ sq ft, so that the area of unheated surfaces is $1600 - 400 = 1200$ sq ft. Therefore

$$u = \frac{400}{1600} = 0.25$$

$$v = \frac{1200}{1600} = 0.75$$

Second Step. Determine the ventilation air quantities. The room volume is $20 \times 20 \times 10 = 4000$ cu ft. If there is one air change per hour,

$$V = \frac{4000 \times 1}{1600} = 2.5 \text{ cu ft of air per hour passing each sq ft of enclosed surface.}$$

Third Step. Find values of K_1 to K_6

$K_1 = 140 - (.25 \times 100) = 115$

$K_2 = 1 + 0.75 = 1.75$

$K_3 = (0.7 \times .75 \times 115) + (1.08 \times .25 \times 100) = 87.37$

$K_4 = (0.7 \times .75 \times 1.75) + (1.08 \times .25) = 1.189$

$K_5 = (0.7 \times .75 \times 115) + (0.4 \times .25\,[115 - 100]) = 61.87$

$K_6 = (0.7 \times .75 \times 1.75) + (0.4 \times .25 \times .75) = 0.994$

The equivalent conductance is therefore

$$C = \frac{0.018 \times 2.5\,[(115 \times 1.19) - (0 \times 1.19) - (.75 \times 87.37)] \times (1.19 \times 61.87) - (87.37 \times .994)}{0.75\,[0.018 \times 2.5\,(.75 \times 0 - 115 + 0) + (0 \times .994 - 61.87)]}$$

$$C = 0.235$$

The overall equivalent heat transmission coefficient is

$$U_e = \frac{1}{\frac{1}{c} + \frac{1}{1.65}}$$

where 1.65 is the outside film coefficient, so that

$$U_e = \frac{1}{\frac{1}{.235} + \frac{1}{1.65}} = 0.206$$

necessary if the assumed panel area and conditions are to be adequate.

Fourth Step. Determine the U_e of the assumed structure. The room air temperature is assumed at 70F, so that the temperature differences for floor and inside walls are (70 — 60) = 10F, for outside wall and glass (70 — 0) = 70F, and the ceiling, being heated, is not included. The inside wall area is (20 × 10) × 3 = 600 sq ft, floor area 20 × 20 = 400 sq ft, glass area 20 sq ft, and outside wall (20 × 10) — 20 = 180 sq ft

Therefore

$$U_e = \frac{U_i t_i A_i + U_f t_f A_f + U_w t_w A_w + U_g t_g A_g}{t_i A_i + t_f A_f + t_w A_w + t_g A_g}$$

$$U_e = \frac{(.20 \times 10 \times 600) + (.35 \times 10 \times 400) + (.30 \times 70 \times 180) + (1.1 \times 70 \times 20)}{(10 \times 600) + (10 \times 400) + (70 \times 180) + (70 \times 20)}$$

$$U_e = \frac{1200 + 1400 + 3780 + 1540}{6000 + 4000 + 12600 + 1400} = \frac{7920}{24000}$$

$$U_e = 0.33$$

The equivalent heat loss coefficient (0.33) is exceedingly high as compared with that required (0.206). Assume, then, that we insulate the walls to a U of .17, double window the glass to a U of 0.55 and insulate the floor to a U of .20. Then

$$U_e = \frac{1200 + (.20 \times 10 \times 400) + (.17 \times 70 \times 180) + (.55 \times 70 \times 20)}{24000}$$

$$U_e = 0.204$$

With the revised structure the assumed panel conditions will be satisfactory, for 0.204 is slightly lower than the required 0.206. To sum up, the room would have a 100F panel, 1 air change per hour, a U_w of .17, a U_g of .55, a U_i of .20 and a U_f of .20.

In the foregoing example, the structure was modified to meet the assumed panel conditions. Obviously the panel conditions are susceptible to change; for example, the panel temperature might be increased or additional surface employed for panels on the walls. A third possibility would be to modify both the assumed panel and structural conditions.

Heating and Humidifying Transport Planes

Development of heating and ventilating systems for airplanes has been so rapid as to be astonishing to the land engineer. And the end is not yet, for pressurizing of cabins has raised many problems, some of which are not even as yet recognized.

In a paper, "Heating and Ventilating for Transport Airplanes," presented at the 52nd annual meeting of the American Society of Heating & Ventilating Engineers, B. M. Brod, engineer, American Airlines, Inc., stated that heating systems for air transports flying at 15,000 ft altitude are usually designed for an outside temperature of —40F; operation at 20,000 ft, anticipated shortly, will require a design temperature of —60F, so that for a 70F cabin air temperature, the heat loss is large and of considerable importance in view of the thin walls involved. The heat loss through these walls is accelerated by the fuselage longerons (longitudinal ribs) which, being of highly-heat-conductive aluminum, transmit heat four times as fast as adjacent sections where air spaces occur between the inner and outer walls.

The author described three types of heating systems, each with advantages and disadvantages. One is the steam system, in which heat from the exhaust is used in a flash-steam boiler; the steam heats a radiator in a duct through which air is forced by the plane's motion over the heater and into the cabin. This system is safe, but heavy, requires excessive maintenance, and is generally cantankerous.

A second system makes use of exhaust heat in a heat exchanger in the ventilating air stream. This method is simple and reliable but heavy and needs frequent checking. The third system is a gasoline burning heater which is efficient, light, and flexible, but has low life, high maintenance, and requires piping of gasoline to the heater.

Heated air is distributed by ducts with outlets along the floor—which give drafts at the ankles—or overhead—with which the heated air cools too fast before it reaches the occupants. A third method is to circulate warm air through the space between the walls and thus obtain radiant heating. Performance data on this warm wall method are not available, Mr. Brod reported.

Ventilation Requirements for Industrial Solvents—Part 3:

Designing Local Exhaust for Solvents

W. C. L. HEMEON

Industrial Hygiene Foundation
Mellon Institute, Pittsburgh, Pa.

This is the third of four parts in Mr. Hemeon's discussion of ventilation for solvents. Having treated dilution rates of vapors subject to convectional dispersion, the author now takes up the design of local exhaust as it is affected by the new dilution concept.

IN our preceding article it was shown that simple general ventilation may be adequate to maintain satisfactory atmospheric conditions respecting solvent vapor concentrations and that in other circumstances forced convection may be required to supplement the general dilution process.

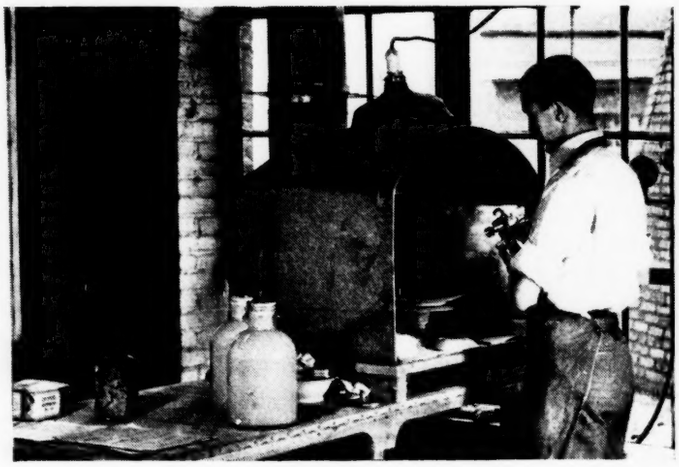
It will often be necessary to apply local exhaust ventilation to the solvent vapor control problem, and the present article will deal with that aspect. It will develop in this discussion that the dilution concept is of vital importance even where local exhaust hoods are to be employed, and neglect of the principle to be elaborated can result in considerable economic waste.

Economical Hood Design

Suppose for example that twenty identical operations generate solvent vapors and that each is estimated to require an exhaust of 2000 cfm, the estimate being based on common principle of local exhaust (e.g., booths with face velocities of 100-125 fpm). The total exhaust capacity would on this basis be 40,000 cfm. If we can demonstrate that, say, 5000 cfm would produce a completely satisfactory result, it is clear that the savings would be enormous in first cost of ventilating equipment, in operating cost for power, in first cost of heated air supply equipment and in fuel for heating the air supply in cold weather.

The design method to be described makes it possible to compute air flows actually required to result in a specific atmospheric concentration in the workroom. It becomes possible to prepare a design, the end result of which can be guaranteed to the purchaser in fundamental terms, whose accuracy is limited principally by the data on rate of use of the solvent. Thus an engineer or contractor might assure his client as follows: "The system proposed will be guaranteed to maintain average concentrations of .....(name) vapor in the normal breathing zone of the worker below (50) parts per million when the solvent is being used at a rate of ..... pints per minute.

In the following examples we will show how the standard dilution rates of Table 3 (H&V:12:45:p97) are employed in the design of local exhaust for solvent vapors, and will describe a new concept, "spillage," that facilitates the computations.



Exhausted Booth

Example 1. A booth is to be constructed on a bench to surround a manual operation involving use of carbon tetrachloride at a rate of ½ pint per hr. The face area of the booth is to be 5 ft × 3 ft = 15 sq ft. It is required to fix a face velocity thus leading to rate of air exhaust for the booth. See Fig. 2.

Solution: We must avoid a design that would be wasteful of exhaust capacity, as when the total air flow required for maintenance of a conventional face velocity of 100 fpm, for example, is greater than needed for adequate dilution of the solvent vapors formed.

Assume face velocity = 100 fpm. The job dilution rate in the present example at a standard dilution rate (Table 3) of 171,000 cubic feet per pint is

$$\tfrac{1}{2} \times \frac{171{,}000}{60} = 1420 \text{ cfm}$$

If the booth were designed to create a face velocity of 100 fpm it would require an air flow of 1500 cfm. Comparing this with 1420 cfm, it is apparent that in these circumstances the air inside the booth and even inside the duct leading from it would be safe since concentrations would be less than 25 ppm. It follows then that with this air flow any ineffectiveness in the exhaust action that permitted partial or even major escape of air from inside the booth out into the general plant atmosphere would be inconsequential for it would expose the worker to concentrations less than 25 ppm. Since experience shows that 100 fpm for ordinary

Table 3 — Dilution Rates for Common Industrial Solvents Recommended for Use in Ventilation Design

(This table is reproduced from the December, 1945, issue for readers' convenience.)

	M.W.	S.G.	Vent. Design Conc.	Dilution Rate Cubic Feet of Air		Possible Complaints if Twice Ventilation Design Concentration Exceeded
				per Lb.	per Pint	
Acetone	58	0.79	150	46,000	38,000	Disagreeable
Amyl acetate	130	0.87	75	41,000	37,000	Disagreeable
Amyl alcohol (iso)	88	0.82	50	91,000	78,000	Disagreeable
Benzol	78	0.88	25	206,000	188,000	Toxic
Butyl acetate	116	0.88	75	46,000	42,000	Disagreeable
Butyl alcohol (n.)	74	0.81	25	216,000	182,000	Disagreeable
Butyl cellosolve	118	0.90	25	136,000	127,000	Toxic
Butyl ether	130	0.77	25	123,000	98,000	Disagreeable
Carbon disulfide	76	1.26	7	750,000	980,000	Toxic
Carbon tetrachloride	154	1.58	25	104,000	171,000	Disagreeable-toxic
Cellosolve	90	0.93	50	89,000	86,000	Toxic
Cellosolve acetate	132	0.97	50	61,000	61,000	Toxic
Chloroform	119	1.50	25	135,000	210,000	Disagreeable-toxic
Cyclohexanol	100	0.96	50	80,000	80,000	Disagreeable
Cyclohexanone	98	0.95	25	163,000	161,000	Disagreeable
Dichlorbenzene (ortho)	147	1.32	50	54,000	74,000	Toxic
Dichlorethylene	97	1.25	75	55,000	72,000	Disagreeable-toxic
Dichlorethyl ether	143	1.22	10	280,000	360,000	Toxic
Dichlormethane	85	1.33	200	24,000	33,000	Disagreeable-toxic
Dioxane	88	1.04	25	182,000	197,000	Toxic
Ether (ethyl)	74	0.72	75	72,000	54,000	Disagreeable
Ethyl acetate	88	0.90	75	61,000	57,000	Disagreeable
Ethyl alcohol	46	0.79	250	34,000	28,000	Disagreeable
Ethylene dichloride	99	1.25	25	161,000	210,000	Disagreeable-toxic
Isophorone	138	0.92	10	290,000	277,000	Disagreeable-toxic
Isopropyl acetate	102	0.87	75	52,000	47,000	Disagreeable
Isopropyl alcohol	60	0.79	150	45,000	37,000	Disagreeable
Isopropyl ether	102	0.72	50	78,000	58,000	Disagreeable
Mesityl oxide	98	0.86	10	410,000	370,000	Disagreeable-toxic
Methanol	32	0.80	100	125,000	103,000	Toxic
Methyl acetate	74	0.96	75	72,000	72,000	Disagreeable
Methyl amyl acetate	144	0.86	75	37,000	33,000	Disagreeable
Methyl amyl alcohol	102	0.81	25	157,000	133,000	Disagreeable
Methyl cellosolve	76	0.97	25	210,000	210,000	Toxic
Methyl chloride	51	0.92	200	39,000	37,000	Toxic
Methyl-ethyl ketone	72	0.81	150	37,000	31,000	Disagreeable
Methyl isobutyl ketone	100	0.80	150	27,000	22,000	Disagreeable
Monochlorbenzene	113	1.11	50	71,000	82,000	Toxic
Nitro ethane	75	1.05	50	107,000	117,000	Toxic
Nitro methane	61	1.14	50	131,000	155,000	Toxic
Pentachlorethane	202	1.67	2	1,000,000	1,740,000	Toxic
Petroleum ether	72	0.63	500	11,000	7,000	Disagreeable
P.M.V. naphtha	110	0.75	200	18,000	14,000	Disagreeable-toxic
Propyl acetate	102	0.89	75	52,000	48,000	Disagreeable
Solvesso	125	0.80	200	16,000	13,000	Disagreeable-toxic
Stoddard solvent	130	0.80	500	6,000	5,000	Disagreeable
Tetrachlorethane	168	1.58	5	480,000	790,000	Toxic
Tetrachlorethylene	166	1.62	100	24,000	40,000	Disagreeable-toxic
Toluol	92	0.87	100	44,000	39,000	Toxic
Trichlorethane	133	1.44	100	30,000	45,000	Disagreeable-toxic
Trichlorethylene	131	1.46	100	30,000	45,000	Disagreeable-toxic
Turpentine	136	0.87	75	39,000	35,000	Disagreeable
Xylol	106	0.88	75	50,000	46,000	Disagreeable

N.B.—The "Ventilation Design Concentrations" in the table are not to be identified with values of maximum allowable concentrations employed in appraising working conditions since all V.D.C.'s include a factor of safety.

operations will not permit the escape of any of the interior air against this velocity, it is to be concluded in this example that the air flow and face velocity are much greater than necessary.

Assume face velocity = 50 fpm. We next cut our estimate to a face velocity of 50 fpm and an air flow of 750 cfm. In these circumstances, the concentration inside the booth and exhaust duct would be twice the specified value, or approximately 50 ppm. If contaminated air were to spill outward from the booth, due to air disturbances and to the low face velocity, it would be subject to the dilution effect of fresh air approaching the booth opening and would be swept back into the booth entrained in the fresh air at an average face concentration which could be calculated. The facts of the problem indicate that ½ of the solvent vapor originating inside the booth could be safely permitted to spill continuously out into the entering stream of air. This means a continuous average spillage of 375 cfm of contaminated air while 750 cfm of fresh air is entering the booth. (750 cfm fresh —375 cfm spill + 375 cfm spill reentering = 750 cfm net.)

Spillage

Thus we introduce a concept, and will refer to it by the descriptive term "spillage." Such an expression in terms of cubic feet per minute permits us more readily to visualize the factors affecting performance.

Spillage means the flow of air (containing the solvent vapors) outward, due either to air disturbances inside the booth, or to air disturbances outside the booth-like natural convection currents or currents due to other ventilating equipment, open windows, etc. In the example discussed above where a spillage of 50% was considered, we described it as an *average*

continuous outward flow of 375 cfm. Actually such spillage would not be continuous but rather irregular, pulsating, and shifting from one section of the face to another. Such irregular interruptions in the flow outward would mean spillage at greater rates than the average, at intervals.

Spillage Rates

Estimates as to possible and probable spillages for various face velocities will be based on experience. Thus the experienced engineer will be readily persuaded that a spillage of 50% against a face velocity of 50 fpm is practically impossible in the circumstances of the example above and will therefore conclude that the air flow capacity may be still further reduced or let it rest at that point content with the generous safety factor indicated.

As an auxiliary design tool we present the spillage rate data of Table 5, compiled specifically for use in the present calculation method. They are, in effect, a tabular description of the writer's experience. The limiting conditions are described in the table. They are not applicable, for example, where there is a heat source inside the booth or other similar air disturbing forces.

The spillage figures state that all vapors originating inside a booth will be retained at a face velocity of 100 fpm; that 10%, on the average, may escape against a face velocity of 75 fpm; and so on, down to 20 fpm when one should assume that nearly all the vapor will escape.

These data are based on the writer's judgment rather than on systematic researches but are believed to be adequate for their purpose, and conservative. The designer, however, should not hesitate to increase them where circumstances are more unfavorable than indicated.

While we have described them as applicable to booth face velocities they may be used also for contour velocities as is illustrated in a later example

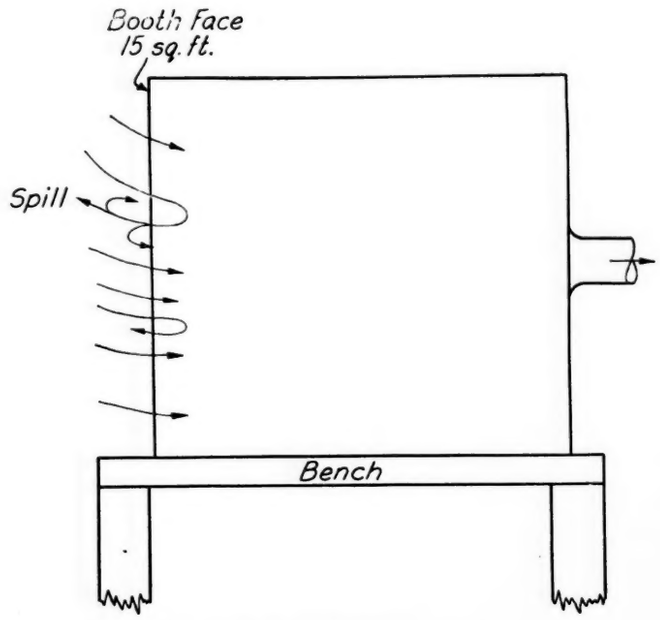


Fig. 2. Booth constructed for solvent exhaust as in Example 1. Note that spill reenters booth in a continuous process so that exhaust rate and fresh air intake are equal. Contaminant reentering offsets spillage.

Tabular Calculations

Further consideration of the example outlined above will be useful in illustrating the utility of the spillage rate table. All the varying elements of the problem are included in the following tabulation which permits a final conclusion to be drawn.

Each horizontal line sets forth the consequences of each assumption as to face velocity. Thus, the third line describes the situation where the face velocity is 50 fpm, as follows:

The air flow is the product of the face area and 50 fpm. Maximum permissible spillage is the percentage ratio of the air flow for the assumed face velocity to the job dilution rate that gives 25 ppm, i.e., $\frac{750}{1420} = 0.53$ or 53%. This value is then compared with the maximum probable spillage for 50 fpm in Table 5, which is found to be 25%. Since the probable spillage is thus found to be less than the permissible spillage, the face velocity is assumed to be too great from the standpoint of economy.

Table 5 — Maximum Spillage Rates for Booths at Various Face Velocities

Where only disturbing air currents inside are those due to ordinary manual operations or natural convection currents.

Booth Face Velocity, fpm	Maximum Probable Spillage in Air, %
100	None
75	10
50	25
40	50
30	75
20	90

Calculations for Booth Problem.

Booth Face Area = 15 sq ft
Job Dilution Rate = 1420 cfm

1	2	3	4	5
Face Velocity, fpm	Air Flow, cfm	Maximum Permissible Safe Spillage, %	Maximum Probable Spillage, % (Table 5)	Conclusions as to Face Velocity. Compare columns 3 and 4.
100	1500	100	None	Too great
75	1120	78	10	Too great
50	750	53	25	Too great
40	600	42	50	Insufficient

It is concluded that a face velocity of 40 to 50 fpm is most suitable, because it is the most economical rate that will maintain concentrations below 25 ppm. This represents a saving of over 50% in exhaust capacity, heating equipment and air supply capacity, and in fuel, when compared with the conventional design method that would have specified 1500 cfm.

In other circumstances the calculation could indicate

that construction of a booth was unnecessary. This would be true, in general, when with a given booth size the calculations indicate face velocities of less than 30 fpm to be adequate and may be true at higher velocities. Decisions as to the need for a booth as against a simple exhaust opening can be made by comparing costs of each method.

Non-Enclosing Exhaust Hoods

Similar methods of calculation to those for booths may be employed for any local exhaust opening.

Example 2. Consider a bench with a back wall and a horizontal exhaust slot in the back wall at the level of the bench top. Assume the bench to be 3 feet wide and 10 feet long and that ethylene dichloride evaporates over nearly all the 30 square foot surface at a rate of 1 pint per hour. The job dilution rate for this amount would be:

$$210{,}000 \times \frac{1}{60} = 3500 \text{ cfm}$$

Instead of dealing with a face velocity, as with booths, we shall deal with a given contour velocity. The fact common to both examples is that the vapors originate inside the contour (curved) surface in one case and the booth face (plane surface) in the other. See Fig. 3.

Solution. We must first define the area corresponding to the booth face area. It may be taken in the present instance as the side area of a quarter of a cylinder with radius equal to the distance from slot opening to the front edge of the bench. By placing the far boundary of the contour at the front edge, the source of vapor is completely inside, while the worker's face is outside the space so defined. The contour area multiplied by the contour velocity (face velocity) gives the rate of air flow.

$$Q = (\text{Area})\ (\text{Velocity}) = \left(\frac{\pi}{2} Lr\right)\ (V)$$

where L = length of cylinder
r = radius of cylinder

$$Q = \frac{\pi}{2}\ (10)\ (3)V = 47V$$

We shall not digress to discuss local exhaust hoods, in terms of contours, as this subject has been reviewed by Brandt (H&V:5:45:p73).

Employing exactly similar reasoning as in the previous booth example, our various calculations take form as tabulated below.

Calculations for Slot Exhaust Problem—No. 2.

Contour area at front of bench = 47 sq ft
Job Dilution Rate = 3500 cfm

Contour Velocity, fpm	Air Flow, cfm	Maximum Permissible Safe Spillage, %	Maximum Probable Spillage, % (Table 5)	Preliminary Conclusion as to Contour Velocity
100	4700	100	None	Too great
75	3520	100	None	Too great
50	2350	67	25	Too great
40	1880	54	50	Just adequate

These calculations lead to the conclusion that 2000 cfm (1880 cfm) will be ample to produce desired results.

Two Vapor Sources

Suppose in a third example, the conditions of Example 1 obtain, but that the operation involves

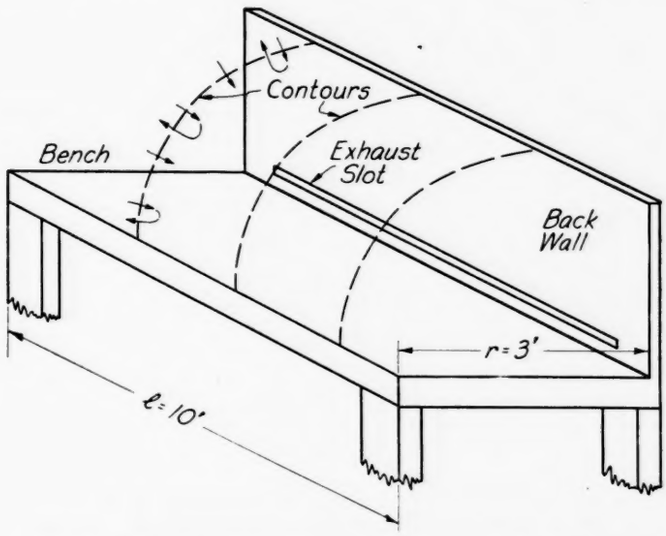


Fig. 3. Work bench discussed in Example 2. Contours indicate surface that is approximate locus of points of equal inward air velocity enclosing all vapor sources.

transfer of the articles from which solvent evaporates to an adjoining bench before evaporation is complete. The additional source of contamination requires consideration by a different set of calculations. It is necessary now to know what proportion of the total solvent has evaporated before the articles are removed from the exhausted booth.

This information can usually be derived by weighing the objects at different stages of the operation. The loss of weight in each step will indicate the percent of total solvent evaporated in any stage.

Two Systems

Two Booth System—Example 3.—Assume in the present example it is found that 40% of the total solvent remains to be evaporated when the articles are removed from the exhausted booth. We shall calculate a design involving a separate booth into which the articles would be placed after removal from booth No. 1. Assume that a face area of 10 square feet is suitable for booth No. 2.

Booth No. 1.

$$\text{Job Dilution Rate} = \frac{60}{100} \times 1420 \text{ cfm} = 860 \text{ cfm}$$

Booth Face Area = 15 sq ft

Assumed Face Velocity, fpm	Air Flow, cfm	Maximum Permissible Safe Spillage, %	Maximum Probable Spillage, % (Table 5)	Conclusions as to Face Velocity
50	750	87	25	Too great
40	600	70	50	Too great
30	450	52	75	Insufficient

Select 35 fpm, or 525 cfm.

Booth No. 2.

$$\text{Job Dilution Rate} = \frac{40}{100} \times 1420 \text{ cfm} = 570 \text{ cfm}$$

Booth Face Area = 10 sq ft

Assumed Face Velocity, fpm	Air Flow, cfm	Maximum Permissible Safe Spillage, %	Maximum Probable Spillage, % (Table 5)	Conclusions as to Face Velocity
50	500	88	25	Too great
40	400	70	50	Too great
30	300	53	75	Insufficient

Select 35 fpm, or 350 cfm.

Total air flow, both booths = 525 + 350 = 875 cfm.

In Example 1, the total air flow required for one booth was 700 cfm. The conditions of the present problem require 25% greater exhaust capacity as well as additional equipment in the form of an extra booth.

Single Booth—Example 4.—An alternate design is, however, more economical for these conditions: that is, a single booth (No. 1), exhausting at a rate sufficient to dilute vapors originating in the second stage to a satisfactory value (25 ppm).

Since the job dilution rate for the portion (40%) originating outside the booth is 570 cfm, then any fresh air flow exceeding this value will dilute this portion of vapor to less than 25 ppm. Fresh air entering the room (and the zone we are considering) under the influence of the exhaust for the booth will effect this result. This applies to general air concentrations.

For conditions close to the face of the booth where the worker is stationed, we proceed on the basis described below. Previous calculations, using spillage figures, were based on pure air approaching the face of the booth. In present circumstances the air would be contaminated by the secondary source of vapor. Therefore, in the following tabulation of calculations we compute maximum safe spillage at the booth on the basis of the "fresh air margin" which is the total air flow induced by the single booth diminished by that required to dilute the secondary vapor to 25 ppm. Expressed differently, the fresh air margin is the total air flow rate minus the job dilution rate for the secondary source.

Solution—Example 4

Single Booth — 60% evaporation (Primary)
Adjoining Bench — 40% evaporation (Secondary)

$$\text{Job Dilution Rate (Primary)} = \frac{60}{100} \times 1420 = 850 \text{ cfm}$$

$$\text{Job Dilution Rate (Secondary)} = \frac{40}{100} \times 1420 = 570 \text{ cfm}$$

Assumed Face Velocity, fpm	Air Flow, cfm	Fresh Air Margin, cfm	Maximum Permissible Safe Spillage, %	Maximum Probable Spillage, % (Table 5)	Conclusions as to Face Velocity
100	1500	1500—570 = 930	100	None	Too great
75	1120	1120—570 = 550	65	10	Too great
50	750	750—570 = 180	21	25	Just adequate

We are thus enabled to conclude that an air flow of 750 cfm through a single booth is suitable as a design figure even though 40% of the solvent evaporates outside of the exhausted booth.

The Principle

As it happens, the difference in required ventilation rate as calculated in Examples 1, 3 and 4 are insignificant. The principle illustrated is the important thing. It may be noted that the general room air concentration where two booths are used (Example 3) would be practically zero, and that in Example 4, it will be $\frac{570}{750} \times 25 = 19$ ppm.

Example 5.—This final problem illustrates a case where dilution cannot be employed. The solvent is carbon tetrachloride but it is evaporated in the booth of Example 1 at a rate of ¼ pint per minute. The job dilution rate will be

$$\tfrac{1}{4} \times 171{,}000 = 42{,}800 \text{ cfm.}$$

It is not even necessary to tabulate calculations, for it is evident on inspection that an air flow of 1500 cfm for a face velocity of 100 fpm will not permit *any* significant spillage, thus—

Maximum permissible safe spillage

$$= \frac{1500}{42{,}800} = 0.035 = 3.5\%$$

Conclusion: Exhaust a minimum of 1500 cfm.

Safety Factors

In special cases it may be desired to produce a room atmosphere with a very high degree of air purity, and it might be reasoned, falsely, that these dilution principles should then be ignored in favor of simple local exhaust calculations. It must be emphasized that the principles discussed in these articles apply even in such cases. If higher standards of air purity are desired in some circumstances, the designer can consider modification of the standard dilution rate for his special requirements but should not ignore the calculations procedure because it may still indicate the way to important savings.

It is appropriate to recall at this point that the dilution rates given in Table 3 were selected to include a liberal factor of safety.

The spillage rate data are also conservative. Recognizing these the designer will seldom need to apply additional safety factors.

Good engineering judgment must be exercised where rates of solvent use vary throughout the day in the selection of basic data. Ordinarily it is well to base calculations on the average-maximum rate of use.

It will be apparent to the reader from the foregoing exposition that the design of ventilation for the control of solvent vapors is susceptible to more exact procedures than in almost any other subject in the field of industrial ventilation.

NEWS OF EQUIPMENT AND MATERIALS

Airkem Odor Control

NAME—Airkem Evapatrol system and Airkem portable Evapatrol unit.
PURPOSE—Both are for odor control and air quality in industry and other enclosed spaces subject to occupancy and industrial odors. Evapatrol system is for use with existing air conditioning or ventilating system; Evapatrol unit is for spaces not serviced by air conditioning or ventilating systems.
FEATURES—Both use Airkem, a chlorophyll air freshener composed of complex group of aromatic substances which, when volatilized indoors, bring objectionable odors under control.

Fig. 1 shows Evapatrol system consisting of reservoir of Airkem with pump, regulator and vaporizer, last being cut into side of plenum chamber or air conditioning unit. Reservoir and regulator are out of sight and remote if desired. Pump forces Airkem into nozzle and vaporizer from where it is sprayed over a cartridge containing excelsior. Some air from the air conditioning unit by-passes through this cartridge and evaporates and mixes Airkem into conditioned air. Regulator can be so set as to control pumping impulse and thus govern amount of Airkem sent through evaporator according to current needs of spaces to be treated.

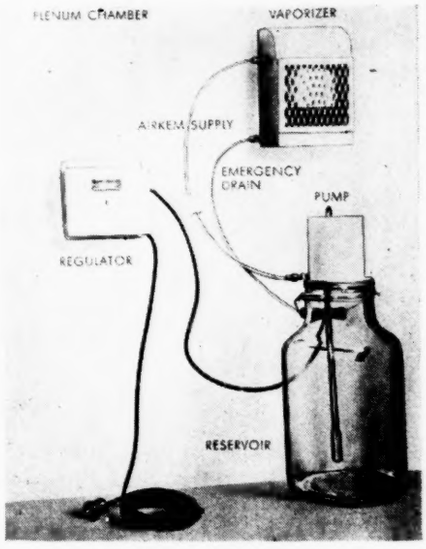


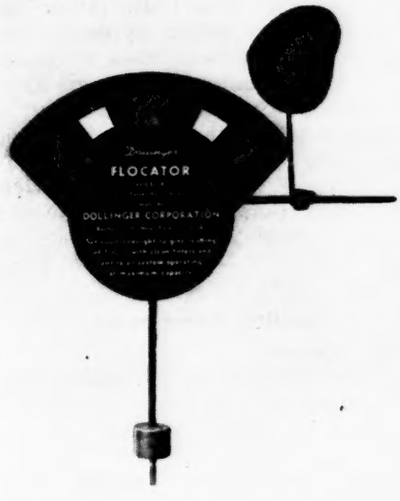
Fig. 1. Evapatrol System.

Evapatrol unit, shown in Fig. 2, is metal cabinet 14 in. square by 27 in. high, mounted on casters. A gauged timing knob on side of portable unit permits variation of the evaporation of Airkem into air to suit needs of spaces to be treated. Portable type differs from Evapatrol system in that supply of Airkem which is evaporated and thrown into the air is handled by motor-driven fan. Units require only refilling of reservoir at necessary intervals and changing excelsior cartridge at infrequent intervals.
MADE BY—*W. H. Wheeler, Inc., 7 E. 47th St., New York 17, N. Y.*

Fig. 2. Evapatrol Unit.

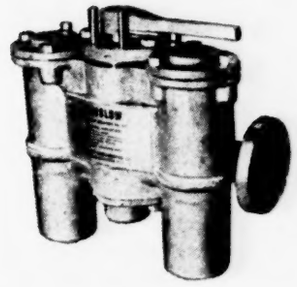
Air Flow Indicator

NAME—Dollinger Flocator.
PURPOSE—Air flow indicator for air ventilating systems.
FEATURES—Instrument will warn against any loss of air flow in a ventilating system. It will show the percentage of maximum flow being obtained at all times. Model 45, illustrated, is for small capacity ventilation and Model 75 for large capacity systems.
MADE BY—*Dollinger Corp., Rochester 3, N. Y.*



Magnetic Filter

NAME—200-MS-1 Winslow Duplex.
PURPOSE—To remove metal particles from fluids in power plants.
FEATURES—Two cylindrical baskets of strainer consist of a main body of perforated steel within which are fine wire mesh linings. Magnets are suspended within these baskets. The one-piece construction incorporates manifold, strainers, inlet and outlet connections, by-pass valves, pressure regulator and main control valve. Hand-operated three-way control valve permits change of flow from one strainer element to the other or through both simultaneously. Flow is maintained through either one or both strainers regardless of position of the valve control lever. One basket can be removed for cleaning while the other one is in service. Where finer filtration of liquids is necessary, cartridge type conditioners can be used in conjunction with the strainer.
MADE BY—*Winslow Engineering Co., Oakland, Calif.*



Controls

NAME—Weatherman.
PURPOSE — To control the inside temperature of buildings.
FEATURES—This device is an outside automatic thermostatic control enclosed in a heavy cast aluminum housing. The time at which heating starts in the morning and shuts off at night is automatically changed as the outside temperature changes. As outdoor temperatures rise to the point where heating is no longer required, all heating stops. When outdoor temperatures drop to an extremely low temperature, continuous heating is automatically produced both night and day. The Weatherman can be used to operate any gas or oil burner, stoker, circulating pump, fans, motor valve or zone control valve.
MADE BY—*Automatic Devices Co., 53 W. Jackson Blvd., Chicago 4, Ill.*

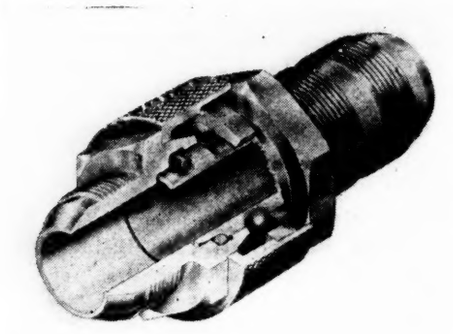
Midget Thermometer

NAME—H-B midget industrial thermometer.
PURPOSE—General temperature measurement in industry.
FEATURES—Instruments are easy to read because of lens-front yellow back tube and scale engraved on glass. Scale ranges are varied and are from

—30 to 700F. Instruments are made in straight and angle types and weigh 5 and 7 oz respectively. The straight type is 9 in. long.
MADE BY—*H-B Instrument Co., 2518 N. Broad St., Philadelphia 32, Pa.*

Coupling

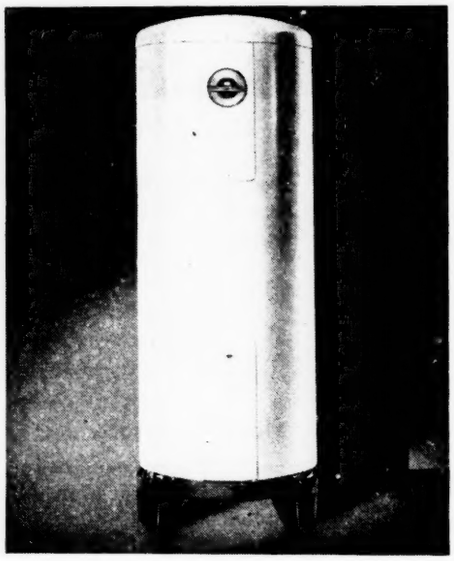
NAME—Roylyn quick coupling.
PURPOSE—For general use on hoses and lines operating under pressure.
FEATURES—Coupling includes three major parts—cam ring, ball cage and nipple. By rotating the cam collar, steel balls are forced inward into a groove in the nipple, thus forcing the halves together. Gasket retained in the ball cage provides a positive seal



and is the separating spring force necessary for the operation of the lock. Application of more pressure tightens the lock, and only the cam collar can unlock it. Couplings are available in aluminum, brass, alloy or stainless steel with gaskets correct for special industrial uses. Safe pressure limit is 1,680 lb per sq in. for the 2 in. coupling and 11,500 lb per sq in. for the ¼ in. unit.
LITERATURE AVAILABLE—Bulletin.
MADE BY—*Roylyn Mechanical Laboratory, 8928 Santa Monica Blvd., Los Angeles 45, Calif.*

Electric Water Heater

NAME—Frigidaire electric water heater.
PURPOSE—For heating water.
FEATURES—Unit has Radiantube heating element which is immersed directly in the water for speedy heating. Being in the shape of a sickle, as the heating element expands and contracts, any scale found on the unit falls off and drops to the bottom. A hot water trap prevents circulation of hot water in the pipes when the faucets are closed. Heater has extra heavy spun glass insulation about 3 in. thick. A cold water baffle plate prevents the incoming cold water from mixing with the water already heated. The gal-



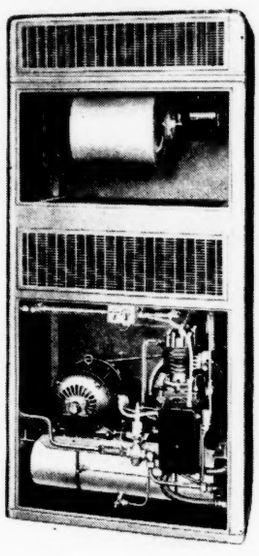
vanized steel tank is enclosed in a rustproofed steel shell finished in white baked enamel. Drain faucet and thermostats are hidden by two plates.
SIZES AND CAPACITIES—Made in 32, 40, 52, 64 and 80 gal, and a 30 gal table top model. The 32 to 64 gal upright models are 57⅞ in. high and the 80 gal is 71⅜ in. high.
MADE BY—*Frigidaire Division, General Motors Corp., Dayton 1, Ohio.*

Sealing Compound

NAME—Uniseal.
PURPOSE—General use as a thread and gasket sealing compound.
FEATURES—Product is a paste of uniform consistency containing no free metallic particles which might set up corrosion due to galvanic action. Compound flows smoothly to form ribbon gaskets. Makers claim it is proof against air, water, steam, gas, gasoline, oil, hydraulic fluids and the aromatics, and that it is insoluble in a wide range of fluids. It is soluble in alcohol and carbon tetrachloride.
MADE BY—*Parker Appliance Co., Cleveland, Ohio.*

Air Conditioner

NAME—Curtis packaged air conditioner.
PURPOSE—Space comfort cooler.
FEATURES—Cabinet of heavy gauge steel measures 88 in. high, 42 in. wide and 24 in. deep. Copper-aluminum coil is designed to remove the proper amount of latent and sensible heat. Filter is located below the coil and is easily removed for cleaning. The fan is driven by a high torque motor through an adjustable V-belt drive. A thermostat is placed in the return air stream. An adjustable grille makes it possible to discharge the air where needed, and there is provision for introducing outside air through the rear



of unit, if desired. The shell and coil condenser has an automatically controlled valve that stops the flow of condenser water when the unit is not in use. Curtis compressor is operated by a 3-phase, 60-cycle, 220-volt motor designed for refrigeration duty. Operation is controlled by two dials located on the control panel in the front. Thermostat adjustment provides for various degrees of cooling. Unit can be supplied with a coil for hot water or steam heating so that the unit then becomes a year round air conditioner.
MADE BY—*Curtis Refrigerating Machine Division, Curtis Manufacturing Co., St. Louis 20, Mo.*

Slide Rule

NAME—Plas-Ten.
PURPOSE—General slide rule use.
FEATURES—This 10 in. universal slide rule is made of plastic with sharp, easy to read gradations. Instrument comes with heavy leather case.
MADE BY—*The Frederick Post Co., Hamlin and Avondale Ave., Box 803, Chicago, Ill.*

Air Cleaner for Home

NAME—Precipitron.
PURPOSE—Electrostatic air cleaner for the home.
FEATURES—Unit is designed for a house where a hot air heating system is available and regular ducts for primary air conditioning have not been installed. Unit is capable of cleaning air for a 6- or 8-room house. A water connection and drain must be provided so the plates may be cleaned periodically. Dust particles in the flow of air pass through a fence of highly charged electric wires which impart positive electric charges to the particles. These are attracted to plates which carry

negative electric charge. Plates retain the dirt until flushed down a drain with water. Operating costs vary from 80 cents to $1 per month. Unit is no larger than the ordinary domestic refrigerator. The Precipitron has been used by industry for many years but this is the first unit designed for the home.
MADE BY—*Westinghouse Electric Co., E. Pittsburgh, Pa.*

Welding Electrode

NAME—Airco No. 312.
PURPOSE—To prevent underbead cracking in the welding of hardenable steels.
FEATURES—Tests have shown this electrode satisfactory for welding low alloy, high tensile steels, particularly in heavy sections where preheat must be used with conventional type electrodes to minimize cracking; free machining steels which normally run quite high to sulfur; cold rolled steels where excessive porosity is normally encountered with conventional type mild steel electrodes.
MADE BY—*Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y.*

Carbide Tipped Drills

NAME—Carbide tipped cyclone drill bit.
PURPOSE—For drilling holes in concrete, brick, marble and masonry.
FEATURES—Makers claim that with these bits, holes in masonry material can be drilled 50% faster than with high speed drills, and that the carbide tipped drills last from 50-75% longer. Carbide does not lose its cutting edge even when running hot. These bits are also used for drilling chilled iron, for cored holes in aluminum, cast iron, and non-ferrous materials.
SIZES AND CAPACITIES—Stock sizes are from 3/16 in. to 1½ in. diameter advancing by 1/16 in.

LITERATURE AVAILABLE—Instruction sheets and general circular.
MADE BY—*New England Carbide Tool Co., 60 Brookline St., Cambridge, Mass.*

Maintenance Paint

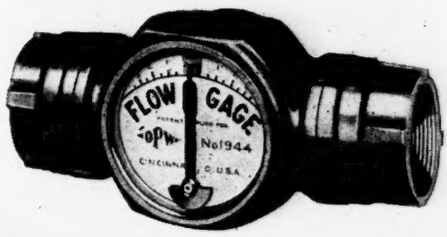
NAME—Pen-Kote 500.
PURPOSE—Chemical resistant surface.
FEATURES—Makers claim paint is quick-drying, odorless, and can be applied to heated, wet and porous surfaces of all kinds. Paint comes in a wide range of colors.
MADE BY—*Peninsular Chemical Products Co., 6795 E. Nine Mile Rd., Van Dyke, Mich.*

Plastic Tubing

NAME—Fibron.
PURPOSE—For hot, corrosive fluids.
FEATURES—Flexible plastic tubing has the ability to remain flexible even after varnish treatment and baking operations. Tubing is resistant to strong acids and alkalies, denatured alcohol, petroleum and its products, and coal tar solvents. Makers claim that it has performed satisfactorily where high dielectric and tensile strengths are important.
MADE BY—*Irvington Varnish & Insulator Co., Irvington, N. J.*

Flow Gauge

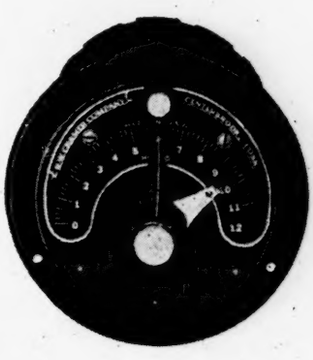
NAME—OPW magnetic flow gauge.
PURPOSE—For flow indication.
FEATURES—Instrument cannot leak as there are no shaft holes, gaskets or packings. Extent of swing of indicating hand depends upon the rate of



flow and velocity of flow moves hand in the direction of flow. Identical indicators are on both sides of the gauge, and the hands are synchronized at all times. Makers claim it will work as readily on extremely low flows as high velocity. The all bronze body is designed for a low pressure drop due to arrangements within the housing.
SIZES AND CAPACITIES—½, ¾, 1, 1¼, 1½, and 2 in.
MADE BY—*The Ohio Pattern Works & Foundry Co., Cincinnati 25, Ohio.*

Interval Timer

NAME—Cramer model E.
PURPOSE—General interval control.
FEATURES—Company's new model has larger dials for easy reading and setting, sturdier frame construction and simplified screw mountings to conform



to standard instrument practice so that the timers may be grouped with other instruments on an instrument panel. Unit can be used to close one circuit and open another at a predetermined interval or to operate signals after a certain time interval.
LITERATURE AVAILABLE—Bulletin on this and other instruments.
MADE BY—*R. W. Cramer Co., Inc., Centerbrook, Conn.*

Spray Nozzle

NAME—Atomizing spray nozzle for domestic oil burners.
PURPOSE—For general use with domestic oil burners.
FEATURES—Makers claim complete, even atomization of liquid throughout

the spray pattern. Body and core are made of brass and the tip is steel with a stainless steel orifice insert. The core end is of stainless steel while an internal strainer screen is of welded monel metal.
LITERATURE AVAILABLE—Catalog No. 22.
MADE BY—*Spraying Systems Co., 4031 W. Lake St., Chicago 24, Ill.*

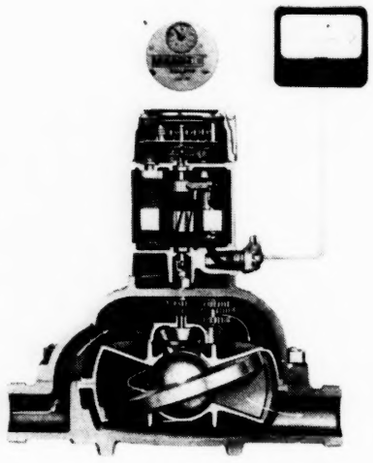
Solenoid Valve

NAME—Allied V5-200 solenoid valve.
PURPOSE—Two-way normally closed valve for use with CO_2, air or hydraulic fluids.
FEATURES—Stainless steel is used wherever contact is made with the

media. Soft seats are used for the elimination of leaks and moisture resistance through the impregnation of coils. It is available for a-c or d-c operation, intermittent or continuous duty, and is rated at 10 watts maximum. Maximum operating pressure is 125 lb per sq in.
LITERATURE AVAILABLE—Bulletin 461.
MADE BY—*Allied Control Valve Co., Inc., South Norwalk, Conn.*

Indicating Flow Meter

NAME—Hays Veriflow Meter.
PURPOSE—For measuring, indicating and totalizing flow of liquids used in industry.
OPERATION — Each complete movement of the measuring piston displaces a fixed liquid volume. Liquid enters through the inlet port and fills spaces above and below the piston. Volume of liquid flowing in the annular space around the center ball of the piston causes the piston to move with a nutating motion until the liquid discharges through the outlet port. Circular motion thus started is transmitted to a gear train.
FEATURES—Instrument has remote indicating feature. A generator is mounted on top of the flow meter, the same shaft operating both the generator and the totalizing register. The indicating



meter measures the output of the generator and the calibrations indicate the corresponding rate of liquid flow through the meter.
LITERATURE AVAILABLE—Bulletin 46-766.
MADE BY—*The Hays Corp., Michigan City, Ind.*

Solder

NAME—Tri-core solder.
PURPOSE—Self-fluxing solder.
FEATURES—Solder wire has 3 independently filled cores of pure rosin flux so that when soldering, there is a continuous supply of non-corrosive rosin flux. Makers claim it is more efficient and less wasteful than the usual single core solder, and that more joints per pound of this solder is possible. Material exceeds ASTM Class A specifications and is available in all alloys, all flux percentages and all gauges.
MADE BY—*Solder Development Division, Alpha Metals, Inc., 369 Hudson Ave., Brooklyn 1, N. Y.*

Pipe Line Strainer

NAME—Zurn pressure and suction pipe line strainer.
PURPOSE—Strainer to protect pumps and moving parts from foreign particles in fluid.
FEATURES—Total area of strainer basket perforations exceeds area of inlet opening by more than 1.5 ratio. Air pressure relief valve on cover permits the escape of air that builds up within the unit. Fitting can be furnished with

a magnetized strainer basket for intercepting ferrous metal particles too small to be stopped by the strainer. High pressure strainers have a removable drop bolted cover while low pressure strainers have yoke clamp covers. Strainer basket is removable.
MADE BY—*J. A. Zurn Mfg. Co., Erie, Pennsylvania.*

Protected Metal

NAME—Koppers Plastipitch.
PURPOSE—A coated metal to resist moisture and chemical fumes, for use as ventilators, ducts and building siding.
FEATURES—Product consists of flat, corrugated or V-crimp steel sheets with the surfaces and edges treated with Plastipitch. Makers claim that compound has a permanent adherence to metal and protects the base from rusting, corrosion and action resulting from chemical fumes and salt water spray. After the compound coating, sheets are provided with additional surface coatings for added protection. Sheets can be fabricated without special equipment and can be bent without impairing the coating.
LITERATURE AVAILABLE—Special 29-page bulletin.
MADE BY—*Koppers Co., Inc., Tar and Chemical Division, Koppers Bldg., Pittsburgh 19, Pa.*

NEWS OF THE MONTH

AIR CONDITIONING

Shortages prevent manufacturers satisfying urgent demands.

According to manufacturers of mechanical refrigeration and air conditioning equipment, more than $2 billion of business is in pent-up demand for their products and they are unable to predict how soon that demand will be satisfied.

• **CRITICAL.**—Production of necessary equipment is held up by labor difficulties in parts suppliers' plants and by shortage of raw materials still on the critical list.

• **CAPACITIES.**—The war years have about doubled the capacity for the manufacturers of air conditioning and refrigeration equipment, according to an industry spokesman, and will be steadily increased in order to meet anticipated demands. Against a pre-war sale of $100 million in a peak year is an anticipated annual business of $330 million after pent-up needs of $1 billion are met.

• **MARKET.**—Potential markets, the spokesman said, include department stores, of which only 3% have air conditioning equipment; drug stores, restaurants, theaters, hospitals, railroad cars, busses, and 31 industries in which air conditioning has been found to be essential such as in food processing, watch manufacturing, printing, cigarette manufacturing, textiles, etc.

• **REFRIGERATION.**—In the domestic refrigeration division of the industry, pent-up demand was estimated to be between 5 and 7 million units with a value in excess of $1 billion. The potential market for home food freezers and locker units is great.

• **RECREATION.**—New projects designed to meet the recreational demands of pleasure seekers are planned for several U. S. cities and will include temperatures controlled to afford the greatest comfort for patrons, according to reports of the Refrigeration Equipment Manufacturers Association. The centers will be completely air conditioned with temperature and humidity regulated in the various sections to fit the physical exertions of the patrons. Projects in which contracts have already been let include centers in Youngstown, Pennsylvania; Toledo, Ohio, and Nashville, Tennessee.

• **STORES.**—According to a survey by a New York advertising agency for Anemostat Corporation of America, only about one in four large stores have even partial air conditioning. It is estimated that competition will force many small stores to install air conditioning in their stores to attract customers and conserve stock.

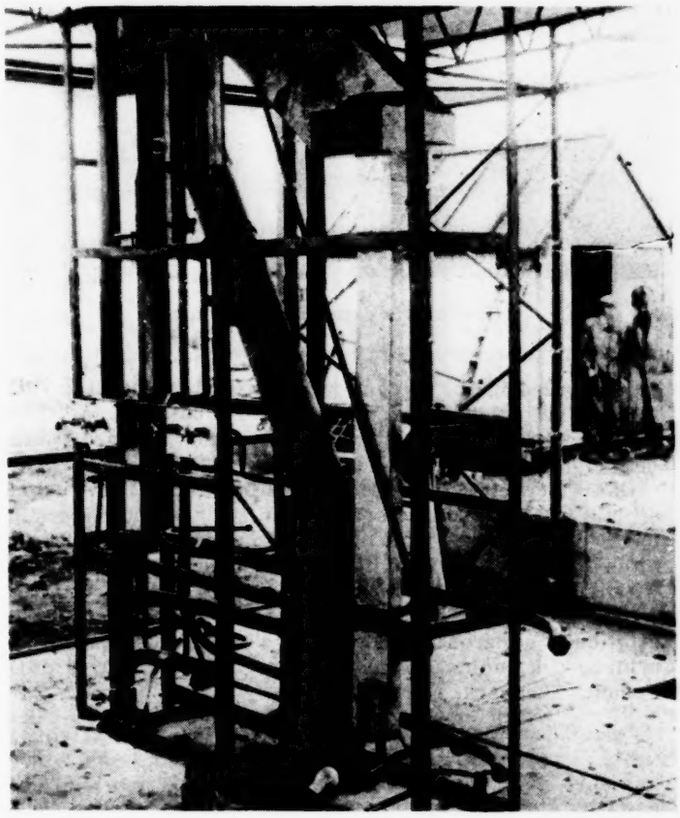
A survey reported in *Chain Store Age* reveals that a total outlay of more than $20 million will be expended in air conditioning chain stores throughout the country this year compared with a total expenditure of $5 million for such purposes in 1941. Based upon information from 517 chains operating 18,666 stores in all fields, a survey shows that 6.6% of all chain stores will be air conditioned this year, bringing the total of all units so equipped to 22.3%. The survey indicated that jewelry chains are air conditioning 33% of their present stores and the power chains will air condition 13.8% of their present stores. Percentages of stores in other chain store fields to be air conditioned were estimated as follows: Drug, 13.7 per cent; candy, 13 per cent; furniture, 11.5 per cent; restaurant, 9.3 per cent; variety and department stores, 7.6 per cent; shoe, 3.2 per cent; grocery, 2.4 per cent, and auto accessory, 2.4 per cent.

• **WAR SURPLUS.**—According to a quarterly progress report of the Surplus Property Administration, the inventory as of November 30 of surplus air conditioning and refrigeration equipment was $1.3 million in consumer goods and $259,000 in capital and producer goods. Figures for heating and fuel burning equipment in this report total $600,000 in consumer goods and $54,000 in capital goods.

BRITISH

Coventry research develops utilities core for England's housing problem.

In an attempt to realize the improvement in domestic comfort envisaged by the British Ministry of Labour in the undertaking of rehousing Britain, a Coventry housing committee, in cooperation with Radiation Limited, developed a central unit for space heating and hot water services, described in the British journal, *The Gas World*.



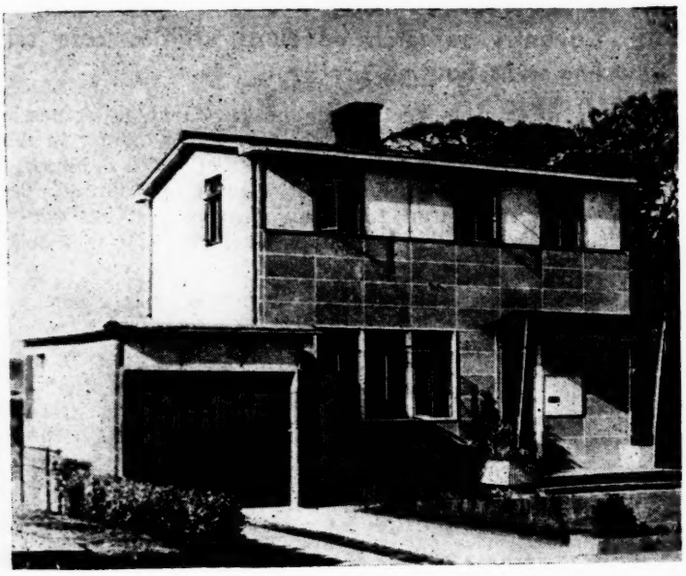
Unit Developed by Radiation Ltd.

• **UTILITIES.**—After three years of experimentation and construction of mock-ups, an experimental kitchen and bathroom unit was developed, complete with all fittings, cooking facilities, and space heating apparatus. The unit centers on a prefabricated duct in which all the services, flues and waste pipes are located for easy access, economy and freedom from frost. The duct is in two sections and incorporates all the services and pipes in the house including a water main, circulating pipes, hot water fittings, gas pipes, flues, vents, steam extracts, piping, etc. The waste disposal arrangement is a one-pipe unventilated system. All pipework is in copper, and the joints are of the capillary solder-ring type. The kitchen and utility side of the unit are faced with aluminum sheet recessed for pot racks, utensil holders, etc.

• **HOUSES.**—Two experimental houses were constructed in which window linings are of galvanized sheet steel

externally and aluminum internally and casements are of galvanized steel or aluminum. Internal door frame are of aluminum with flush doors fitted to recess hinges.

• **HEAT.**—The space and hot water heating of the houses are accomplished by Radiation's slow combustion stove with back boiler fitted in the livingroom, in an anodized aluminum surround. The boiler provides heat for a hot water tank and for three concealed radiators. A Radiation gas cooker and a 1½ cubic foot Electrolux gas refrigerator



Coventry's experimental house.

are installed in the kitchen adjacent to the stainless steel kitchen unit. The laundry consists of a built-in gas heated washing boiler and a gas heated drying cubbard. Each bedroom contains a gas heater.

Gas, electricity, water and any other utility services are all laid in a common excavation and the gas and electricity have their intake in a common meter cubbard in the kitchen, located so that inspection of meters is permitted without entry into the house.

• **WORLDWIDE.**—This tendency toward a central core of utilities is apparently undergoing a worldwide upsurge as evidenced by units produced in the U. S. (H&V:2:46:p94), Canada, Denmark, Norway, France.

HOUSES

States take independent action to aid government housing program.

Independently, but indirectly aiding Mr. Wyatt's program, described in *Washington News*, page 49, an increasing trend toward state legislative action of both an emergency and long-range character to stimulate housing construction is revealed by a survey of developments in state capitals throughout the country.

• **STEPS.**—Attacking the problem of getting postwar building under way from varied angles, the states are taking such divergent steps as putting local governments into the housing business on the one hand, and encouraging private enterprise to broaden its housing activities on the other.

While less spectacular than Washington action, the state developments may in some instances prove of more lasting significance to the building and related industries. Such steps as elimination of outdated local building code obstacles are necessary to any real solution of the housing problem. Other action of vast importance includes the clearance of state legal obstacles from the path of large-scale investment of private capital in residential real estate by such groups as the life insurance industry, with its $49,000,000,000 of assets. (H&V:2:46:p101.)

• **N. Y.**—In attempting to solve the emergency need of housing for veterans, the states in a number of instances are moving to use their own resources rather than leaning so heavily on the federal government as was the general tendency both during the war and in the depression decade. As one step in its emergency housing program, New York State's legislature this year passed a bill appropriating $35,000,000 for temporary dwellings.

Another bill in the New York program, which was on its way to passage at this writing, would permit municipalities to grant tax exemption for a period not to exceed 12 years on alterations and improvements to dwellings. The measure also authorizes abatement of taxes on the entire property up to 80 1/3 per cent of the cost of rehabilitation during each year. Another New York bill would increase the subsidy for permanent low cost housing from $6,250,000 to $9,000,000.

• **MASS.**—Enacted by the Massachusetts legislature was a bill granting broad emergency powers to cities and towns to provide housing for war veterans. The measure empowers local governments to: Raise and appropriate money for veterans' housing; take land by eminent domain on sites on which to erect temporary shelters; and borrow outside the debt limit up to ½ of 1 per cent of their valuations for five-year bond issues to finance such programs. Another bill introduced in Massachusetts would authorize a $25,000,000 state bond issue, with which the State Housing Board would buy land and build homes with preference in renting or sale to veterans.

• **R. I.**—A bill introduced in the Rhode Island legislature would give sweeping powers to municipalities to undertake construction of dwellings for veterans and their families. The measure would empower municipalities to raise and appropriate funds directly to provide housing for veterans, or to match federal grants that might be made available.

• **VETS.**—Illinois has contributed $4,300,000 to the Chicago Housing Authority for use in acquiring land for veterans' housing. A bill providing for state loans to veterans for home or farm purchase was on its way through the Mississippi legislature, modeled after laws already effective in a number of states. California's legislature, in special session, was considering expansion of its program of farm and home loans to veterans, along with an appropriation to help finance conversion of federal war housing to veterans' housing use.

Another form of state action to meet the emergency situation was the Minnesota governor's appointment early this year of a state "housing expediter" to work with building supply industries and federal agencies on materials distribution; with local communities on pressing unused buildings into service; with building trades unions to gain their support in speeding home construction, and with federal agencies to foster municipal participation in their programs. A state committee in Minnesota has been studying housing needs and factors retarding production.

• **COLLEGES.**—Provision for housing for veterans attending colleges is causing a problem in many states, with action being taken to relieve the situation. Pending at this writing in the Missouri legislature was a bill appropriating $5,366,570 as the state's share of a $10,500,000 construction program at state-supported colleges to provide housing facilities for veterans and others. Funds to match the state's share would be obtained from the sale of revenue bonds which would be redeemed by the net proceeds of rentals of the housing space.

In Massachusetts, Gov. Tobin called for passage of legislation authorizing the Massachusetts State College Building Association to construct additional dormitories at a

cost of $400,000 to house veterans. These dormitories would be leased to the state and operated on a self-liquidating basis over a 20-year period. Similar steps are being taken in other states.

• **BLIGHTED AREAS.**—Continuing into current-year legislative sessions, with probable further action next year when more legislatures will convene, is a trend toward the enactment of legislation to facilitate investment of private capital in the rehabilitation of blighted housing areas. At least 13 states last year enacted such legislation, with prospects that more will follow suit. The general pattern of these measures is to authorize either municipal agencies or private redevelopment corporations to acquire blighted areas by eminent domain powers for subsequent development by private capital. Tax advantages are offered in some instances as an additional inducement. States in which such legislation was being sought at this writing included Missouri, Rhode Island and others.

• **CODES.**—The states also are acting to remove the obstacles to building caused by archaic local building codes. Rhode Island's legislature passed a resolution urging municipal governments to examine building and zoning codes so that restrictions and cumbersome procedures may be eliminated to expedite construction of new dwellings. New Jersey's legislature was urged by the Building Contractors of New Jersey to draft a modern, uniform building code which could be adopted inexpensively by municipalities. A committee functioning under the State Department of Economic Development has been preparing such a standard minimum code for residential buildings.

Introduced in the New York legislature were bills to empower the state housing commissioner to establish residential construction standards which cities, towns and villages could adopt as their own building codes. Similar action has been taken in recent years by Indiana, Connecticut and other states. Municipal action to modernize building codes has been making increasing progress and was under way at this writing in several major cities, including Chicago and Cleveland.

ELECTRICITY

$4,500,000,000 Business Predicted for Age of Electrical Living.

• **BIG BUSINESS.**—The modern age of electrical living now dawning in American homes will provide jobs for more than 600,000 men and women and will mean an annual business of $4,500,000,000 during the next five years, B. W. Clark, Vice President in charge of sales for the Westinghouse Electric Corporation, forecast to metropolitan newspaper and magazine editors at a preview of 1946 Westinghouse home consumer products at the Waldorf-Astoria.

The theme of the preview was set by a color film "The Dawn of Electrical Living," prepared by the Walt Disney Studios in Hollywood for Westinghouse as the company's contribution to the industry program to inform the public of the importance of adequate wiring in new and old homes.

"When we began planning this preview some months ago, we neither realized nor even imagined our country would be plunged into industrial strife, but no matter how serious our troubles seem today, the future of this business of electrical living is vast and certain. Nothing can stop it," Mr. Clark said.

• **PRODUCTION.**—A more detailed analysis of production difficulties was presented by J. H. Ashbaugh, vice-president in charge of the Electric Appliance Division of the Westinghouse Company, who pointed out that "reconversion" of manpower to normal peacetime efficiency has been one of the division's knottiest problems. He said that although the division's predicted reconversion schedule had been met up to the time of the electrical strike, and employment was only 400 below the prewar peak of 5,500, yet production was 40 per cent below prewar output, due to the necessity of retraining employes, shortages of materials, and the general problems involved in reconversion.

These factors, added to a cost-of-production increase of 25 per cent, and losses due to lack of parts, substitution

Showing model of housing circuits with circuit breakers.

of materials, and extra handling, have served to "almost double" production cost of the appliances so far produced.

Mr. Ashbaugh declared that "we shipped 92 per cent of all appliances produced in the year 1945." Commenting on future appliance production schedules, he said that, due to uncertainties caused by the strike, "it is my feeling that we will see summer come and go before appliances are available in any quantity."

• **CURRENT DOUBLED.**—"As an example of how electrical living is taking hold, the average home consumer in 1935 used 600 kilowatt hours of electricity per year. In 1942 that consumption had reached 1,022 kilowatt hours, and—surprisingly enough, in spite of the fact that no new appliances were being made—it reached more than 1,200 kilowatt hours per year in 1945. That translates into a total use of 30,000,000,000 kilowatt hours per year, or at an average of three cents per kilowatt, $900,000,000 per year. The unit rate, by the way, is little more than half what it was more than ten years ago, another fact that has contributed greatly to the rapid growth in home use of electricity," Mr. Clark said.

Explaining how the principles of electrical living could be made available to home owners in all income brackets, Irving W. Clark, manager of the Westinghouse Better Homes Department, and host at the preview, described the four basic economic levels as "thrift," "budget," "ideal," and "deluxe," and showed the degrees of improvement in electrification which each level entails. The Better Homes Department uses this yardstick as a guide for prospective home builders in planning their electrical wiring and equipment, Mr. Clark explained.

• **DISPLAY.**—Among the new aids to electrical living on display at the Westinghouse preview were the automatic cycle Laundromat, a washing machine that washes, rinses, and damp dries clothes in half an hour; upright home freezers, a new product available for city and farm use with front-opening doors and sectional inner doors for easy food storage and removal; an electric roaster, with an 18 quart capacity and featuring a "look-in" glass panel; the home central unit Precipitron, an electrostatic air

cleaner, and the Waste-Away, a garbage disposal unit that will grind up garbage and flush it down the kitchen drain.

The home radio sets displayed included table and console models. The 1946 small appliances—toasters, coffee makers, waffle bakers and similar appliances—have been restyled by Lurelle Guild, Westinghouse design consultant.

EDUCATION

Two short courses in warm air heating sponsored by Warm Air Association.

The National Warm Air Heating and Air Conditioning Association is sponsoring two courses this year, each of four days duration. The 15th Annual Forced Warm Air Conference at Michigan State College, Lansing, Mich., will be held March 18-21 inclusive, and the 1st Annual Warm Air Heating Conference at Syracuse University will be held April 15-18 inclusive.

• **PROBLEMS.**—The course at Lansing, Michigan, will be divided into two groups as in the past. Group I will devote its time to "The 1946 Problem House", the small home of the immediate future. Group II will devote its time to "A Building Heated Intermittently", a small neighborhood church.

The Syracuse course in April will confine its entire time to "The 1946 Problem House" which will be very similar to the Group I course at M.S.C. The course laboratory fee for both conferences will be $10.00.

• **LECTURES.**—Lectures will be delivered at both meetings by Professor E. A. Allcut, University of Toronto, on the meaning of U factors for building materials; Professor S. Konzo, University of Illinois, on design temperatures; B. F. McLouth, Minneapolis-Honeywell Regulator Co., on how to check frame house construction; H. F. Randolph, International Heater Co., on what to expect from panel heating. Many other prominent lecturers will participate in one or both courses.

General chairman of the Michigan meeting will be Ed Root, Detroit Safety Furnace Pipe Company. General chairman of the Syracuse course will be Professor Lorin G. Miller, Head of Mechanical Engineering, Michigan State College, East Lansing, Michigan.

• **COMPREHENSIVE.**—The Michigan and Syracuse courses will carry the student through a design program from the making of a comfort survey (W. C. Redrup, the Majestic Company), heat loss calculations, layout, selection of furnaces and blowers, and controls. Students are requested to bring triangles and scales so that they can carry through the design procedures demonstrated. Professor Miller will release further details.

WELDING

Pressure Vessel Research Begun.

• **COUNCIL.**—A comprehensive Pressure Vessel research program covering materials, design, frabrication, inspection and testing of unfired pressure vessels has been started by the Welding Research Council, which is sponsored by the American Welding Society, American Society of Mechanical Engineers, American Institute of Electrical Engineers and other engineering societies. This program has been initiated to answer the need for quantitative data by those engaged in pressure vessel design and construction to insure sound design and reasonable life. During the war, experimental work had fallen behind the increased use of both carbon and alloy steels in larger and more complex designs of welded vessels used in process industries under increasingly severe service conditions. The lack of factual information, has resulted in acknowledged over-conservatism in design and has hastened the start of the new research program.

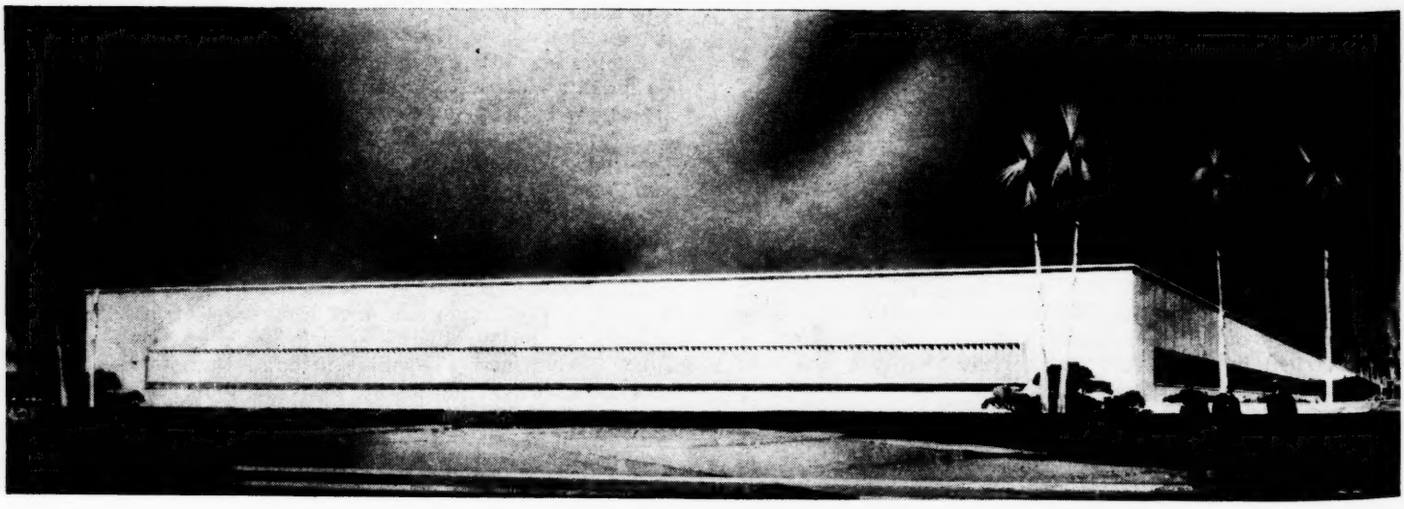
• **COMMITTEE.** — The chairman of the new Pressure Vessel Research Committee is Walter Samans, who is also chairman of the ASME Boiler Code sub-committee on unfired pressure vessels and the first meeting of the new committee was held on January 10, to sift those problems of greatest need, based on reports of defects developed in service, and to plan coordination of the new investigations with other committees and research already being conducted. At this meeting, employment was authorized of a full-time New York headquarters secretary.

SUNSHADE

Sun deflecting windows shield west wall of California plant.

• **NEW.**—Sun-deflecting windows, widely used in Brazil, are incorporated in the design of a plant now being constructed for the Chevrolet Motor Division of General Motors at Los Angeles, Cal. It is believed that this is the first use of this type window used industrially in this country.

• **FEATURES.**—The sunshade feature consists of deep-set windows fronted by fixed panels which resemble a venetian blind stood vertically. Concrete panels are specified for these shields. Each panel is 2 ft long and 7 ft high and is so angled that sunrays cannot reach the window glass and transmit heat to the interior. These windows will be on the west exposure of the three major buildings of this development. A continuous band of steel sash 7 ft high



New Chevrolet plant in L.A. will have sun deflecting windows by Albert Kahn.

will extend the full depth of the south, east and north exposures.

Donals B. Parkinson, Los Angeles, is the architect, and Albert Kahn Associated Architects and Engineers, Inc., consultants. The overall pattern follows closely the Kahn designed expansion of the Chevrolet plant at Flint, Mich.

PROJECTS

Large housing developments to be guided by new company.

A new pattern for the solution of the nation's long range number one problem—the acute housing shortage—has been indicated by Allan S. Harrison, formerly director of public housing for the City of New York, who announced his resignation from the city's Housing Authority to establish, with two partners, a new enterprise which he calls

L. to R., Messrs. Harrison, Ballard & Allen.

"the nation's first private housing authority and which will be known as Harrison, Ballard & Allen.

The partners will be William F. R. Ballard, architect, who was retained by the New York City Housing Authority in the design of several of its large projects, and Frederick H. Allen, Deputy Mortgage officer of the Bowery Savings Bank, who also has resigned from that post.

• **AIMS.**—The new organization will assume the coordination of all activities in connection with a complete development or community. The firm will function as owner's agents in the creation of multi-family housing developments and communities, retaining such services as architects, engineers, and contractors and controlling all or part of the process, including determination of the most efficient method for heating, supply of utilities, and garbage disposal in accordance with the owner's requirements, from inception of the project to setting up of management staffs. The organization, says Mr. Harrison, will be prepared to carry through to completion projects which otherwise would require contacts with promotors, real estate representatives, financial experts, architects, engineers, landscape architects and other agencies.

• **BACKGROUND.**—Since 1938, when he became director of Public Housing, for New York City, Mr. Harrison has been responsible for design, construction and management of approximately $100 million of subsidized low rental housing in New York City. During the war years he was on leave of absence and supervised approximately $40 million worth of construction for the Army and Navy.

Mr. Ballard was formerly associated with the New York City Housing Authority as a technical director. He also carried on an architectural practice in New York from 1932 to 1942 during which time he was retained by the authorities in the design of several of its larger projects.

Mr. Allen is also a graduate architect from the University of Virginia and was associated with the builders of the Empire State building. Since 1932 he has been in the market and real estate department of the Bowery Savings Bank where he developed the first large mortgage portfolio survey in New York and in 1942 edited and published a book analyzing the New York region's real estate and housing problems.

• **OUTLOOK.**—"Naturally", says Mr. Ballard, "we are 100% behind Mr. Wyatt's housing program. As for the heating and ventilating of any project we may undertake, the nature of such installations will depend upon the various factors entering into the construction of each project".

CONTROLS

New York Apartment Projects To Have Personalized Heating.

Personalized heating controls, the new system which makes it possible for each tenant to regulate the temperature of his own apartment, will be introduced in New York apartment dwellers for the first time in four new projects to be built this year by City Investing Co., one of the largest real estate holding concerns in Manhattan.

• **HOME COMFORT.**—The apartment buildings, among the first to be constructed in Manhattan since the war, will contain numerous improvements to give private home comfort to occupants of multiple dwelling units. Robert W. Dowling, president of City Investing, said the central theme of the design and construction emphasized home-like conveniences.

In keeping with this trend, the personalized heating controls, developed by Minneapolis-Honeywell Regulator Co., make it possible for each occupant to select the temperature he prefers, through an individual thermostat operating a motorized valve which regulates the amount of heat delivered to each apartment.

• **IN WORK.**—Construction of the new buildings, which will house approximately 60 families each, will be well under way this spring. Excavating has started on two of the properies and steel construction will begin on one in March and another in April.

CONVENTION

Technical sessions show variety at 52nd ASHVE meeting.

Technical papers at the 52nd annual meeting of the American Society of Heating and Ventilating Engineers held in New York (social events, new officers described in last month's H & V, page 132) included the following:

• **WATER.**—Dean John A. Goff and S. Gratch (Towne Scientific School, University of Pennsylvania) reported on "Low-Pressure Properties of Water from —160 to 212F," the result of a comprehensive study of the properties of moist air, a cooperative project between the ASHVE and the Towne School. A critical study of standard steam tables by the authors indicated that present water data were inaccurate in the range of temperature below 212F. The present paper is the result of an attempt to improve these data. The authors presented revised data, believed to be more accurate than previous tables, on spectroscopic constants, enthalpy and entropy at zero pressure, enthalpy coefficients, and vapor pressure of ice.

• **HOT ENVIRONMENT.**—"An Experimental Investigation of the Effect of Change in Atmospheric Conditions and Noise Upon Performance," by Dr. Morris S. Viteles, University of Pennsylvania, and Dr. Kinsley R. Smith, The Pennsylvania State College, contained information from a study made for the Navy in cooperation with the ASHVE to determine whether the use of air conditioning equipment was justified on naval vessels. The work done by the subjects investigated was plotting and charting, where speed, accuracy and morale are of importance. The authors concluded that (1) there is no need to provide equipment for the reduction of effective temperatures below the 80F level where tasks of the type included in this investigation are to be performed. There is some evidence that it may be undesirable to do this type of work at effective temperatures as high as 87F but further investigation, within this range of approximately 80F to 90F is required to determine more exactly the critical level of temperature. Also (2) that it is unnecessary to undertake considerable expenditure of funds to reduce the noise involved in the cooling and circulation of air, at least if such noise does not rise above the 90 db level. In general it would appear that the effect of high temperature on performance is much more adverse than that of high level of noises of the type reproduced in this experiment.

A somewhat similar study was that reported in "Physiological Response of Subjects Exposed to High Effective Temperatures and Elevated Mean Radiant Temperatures," by Clark M. Humphreys, senior engineer, Oscar Imalis, former research physicist, and Carl Gutberlet, former assistant research engineer, all of the ASHVE Research Laboratory, reporting the result of an investigation made for the Navy prior to and during the war and recently released for publication.

The object of the project was to determine the physiological reaction of men exposed for four hours not only to hot air but surrounded by hot surfaces. Among the results reported were that physiological reactions are comparatively little affected by relative humidity; the effect of radiant temperatures on physiological reactions decreases as the effective temperature increases and becomes surprisingly small in the upper limits; by repeated exposure to hot environments for four hours or less each day, a person can acquire in two weeks, or longer, a considerable degree of acclimatization.

• **REPORTED ELSEWHERE.**—Condensations of other papers appear elsewhere in this issue, as follows: Professor F. W. Hutchinson's (Purdue) paper on "A Single Equation Design Procedure for Radiant Panel Systems," page 80; the paper "Heating and Ventilation for Transport Airplanes," by B. M. Brod (American Airlines) on page 81; Dr. F. M. Allen's paper on "Therapeutic Uses of Low Temperature" on page 57.

• **NEW PRESIDENT.**—Alfred J. Offner, 1946 ASHVE president, is a consulting engineer in New York City. He has been on the ASHVE Council since 1935, served on various committees, is a past-president of the New York chapter, and a past-president (two terms) of the New York Association of Consulting Engineers.

WASHINGTON NEWS

(Continued from page 51)

and standardization of building codes throughout the country. When housing begins to move in interstate commerce over such trademarks as Kaiser, Higgins and U. S. Steel, it may not be long before antedated restrictions disappear.

Labor's attitude is something else again, but it should be observed that the A. F. of L. concurrently issued a statement supporting the Wyatt housing plan.

• **CONTROLS.**—While Congress may toy for some time with the various units of the Wyatt program, of immediate interest to heating, ventilating and air-conditioning industries is the fact that the Civilian Production Administration was expected to crack down at once on nonessential building. Stopping of some commercial building already in progress was under consideration as February ended. Details were still being written into a new order, but it seemed almost certain that tight limits would be placed on the building of factories, stores, office buildings, recreational structures and public works projects.

• **MISCELLANY.**—*Gas-fired Conversion Burners:* Amendment 9 to Order 48 under Price Regulation 591, effective February 5, substitutes the term "gas-fired conversion burner" in the place of "furnaces" or "unit heaters" in order to correct Amendment 8 to the order. The definition of resellers is also clarified.

Low-Pressure Steel Boilers: Amendment 10 to Order 48 under Price Regulation 591, effective February 16, authorizes manufacturers of low-pressure steel boilers to increase their prices 14% over their October, 1941 prices. The amendment also specifies a profit factor of 7.2% which the manufacturers may use in applying for individual price adjustments on these items. The 14% increase will be passed on to all levels of sale since resellers' margins are not adequate to permit absorption.

Motors: Direction 11 to Priorities Regulation 28, effective February 18, provides for the assignment of CC ratings to manufacturers of fractional horsepower AC electric motors to get capital equipment which cannot be obtained without a rating. The equipment must result in substantially increased production, however, or be needed to replace equipment which is in danger of breakdown. CC ratings may also be assigned for MRO supplies, construction materials and production materials other than electric sheet steel.

Sheet Steel: Direction 12 to Priorities Regulation 28, effective February 18, provided for the assignment of CC ratings to producers of electrical high silicon sheet steel for capital equipment unobtainable without a rating.

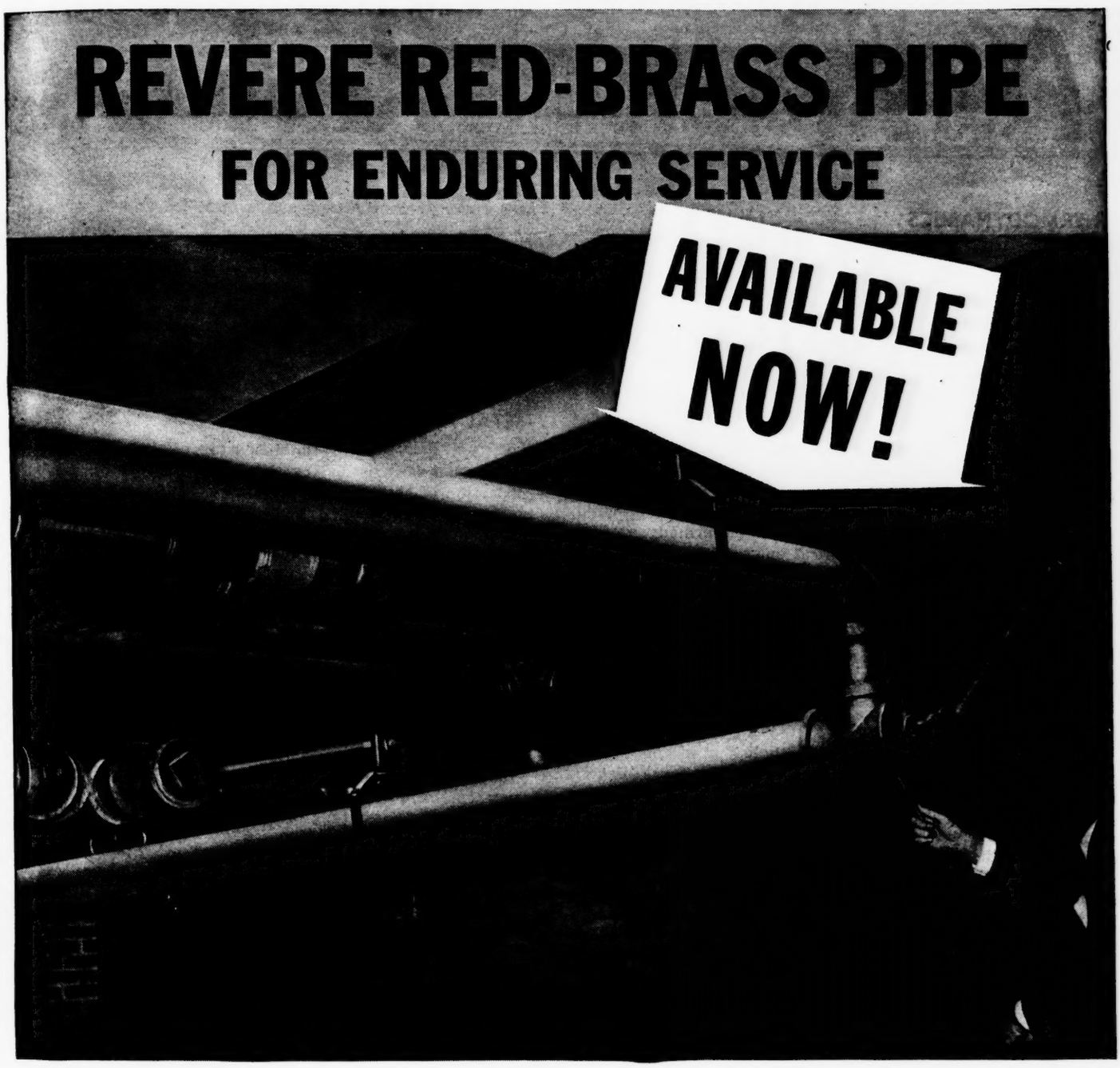
Steel Strike Aftermath: To supplement the efforts of steel producers to apportion inadequate quantities of steel coming into the market since the settlement of the strike, CPA was planning, late in February, a drastic revision of Priorities Regulation 28, which grants special CC ratings for bottleneck producers. Because inventories were wiped out during the steel strike, thousands of producers became eligible for priorities assistance under terms of the original regulation. The revision was to practically wipe out CC ratings and grant only AAA ratings for emergency purposes.

Solid Fuels: The Solid Fuels Administration for War has announced that it will discontinue all activities by June 30. Most of its orders and regulations will expire or be revoked by March 31. After April 1, however, the agency will meet emergency conditions, continue to exercise its authority to issue directions under Solid Fuels Regulation 1, and to exercise limited control over solid fuels exported.

Carbon and Alloy Steel Products: The nation's steel mills have been authorized by the Office of Price Administration to sell carbon and alloy steel products on an adjustable pricing basis. This authorization is effective as of February 15, 1946, the date upon which Stabilization Administrator John C. Collet directed OPA to increase carbon and alloy steel mill products an average of $5 per ton.

The directive requires OPA to issue revised ceilings totalling 90% of the increases within two weeks from the date of the directive. When the action increasing these ceilings is issued, it will be accompanied by a statement of considerations giving the ground on which the action was found by the price administrator to fall within the bounds of the new wage-price policy.

Mills may bill customers at present ceiling prices with the proviso that the customer pay the mill difference between the present ceiling prices and the new ceiling prices for various products to be established by OPA.



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Abstracts AND Reviews

THERMODYNAMICS

Thermodynamics is a study that is linked with many fields of applications such as heating, air conditioning, power engineering, physics and chemistry. While the basic fundamentals are the same in all fields, the applications vary. For that reason, Barnett F. Dodge, Professor of Chemical Engineering, Yale University, drew upon his experience of many years as a teacher, and has written a text book on thermodynamics that is prepared particularly for those in the field of chemical engineering.

The first six chapters of the book are devoted to basic fundamentals and the development of formulas. The remaining seven chapters apply the fundamentals to specific operations and processes. The author has included 135 solved illustrative problems which he considers the worthwhile feature of the book. They show that thermodynamics can be a useful tool to the chemical engineer.

Of particular interest are the chapters on thermodynamic properties of fluids; thermodynamics of fluid flow; heat transfer; and refrigeration.

Chemical Engineering Thermodynamics, by B. F. Dodge. Cloth bound, 5½ x 8¾ in., 680 pages. Published by the McGraw-Hill Book Co. Price, $6.

CHEMICAL DICTIONARY

Hackh's Chemical Dictionary which has now gone into its third edition, is truly a volume that should find a place on the bookshelf of all who are interested in the broad field of chemisty. It is edited by Dr. Julius Grant who worked with the late Ingo W. D. Hackh as collaborator of the earlier editions.

This new edition carries out the ideas of Hackh that a chemical dictionary should give clear, precise statements of the theories, laws and rules; list concisely the important reactions, processes and methods; mention the chemical apparatus, equipment and instruments; note the investigators who built-up the science; and describe the elements, compounds, drugs, and products of the field.

The dictionary contains 57,000 definitions. The various chain reactions are illustrated by formulas. Compounds are listed with data on formula, molecular weight, synonyms, occurrence, appearance, density, melting and boiling points, solubility and uses. Special care has been given to balance the treatment from the American and British points of view.

Hackh's Chemical Dictionary — 3rd Edition, edited by Julius Grant. Cloth bound, 6½ x 9½ in., 925 pages. Published by The Blakiston Co. Price, $8.50.

PSYCHROMETRIC TABLES AND CHARTS

Since a knowledge of the properties of air-water vapor mixtures is essential in many industrial operations such as drying, refrigeration, air conditioning, it is important to have psychrometric data over a wide temperature range for the design engineer.

The authors have provided a complete range of temperatures from —100 to 1,000F. Both tables and charts are included since each has certain advantages. For many purposes the charts will be found more useful but where maximum accuracy is desired, the use of the tables is indicated. The book includes volumes and enthalpies of dry air, water vapor and saturated and partially saturated air; saturation humidities at one atmosphere and various other barometric pressures; humidities along percentage-saturation curves; humidities along adiabatic-saturation lines; percentage relative humidity as a function of wet and dry-bulb temperature difference; properties of water and saturated steam; vapor pressure of water, ice and super-cooled water.

Tables and charts face the same way so that the reader does not have the inconvenience of turning the book from one direction to another. One chapter is devoted to illustrative problems.

Psychrometric Tables and Charts, by O. T. Zimmerman and I. Lavine. Cloth bound, 11 x 8½ in., 162 pages. Published by Industrial Research Service. Price, $6.50.

METAL-ARC WELDING

A book specially for the inspector of manual metal-arc welding has been issued by the American Welding Society. Inspection of assemblies fabricated by this form of welding involves a great many factors which include not only the actual operation of welding, but also related subjects such as basic property of welds and parent metal, testing methods, and interpretation of drawings and specifications.

The text covers the requirements and duties of a welding inspector, methods of testing welds, the inspection of welds by visual, magnetic-particle, and radiographic methods. There is one section devoted to the principal type of weld defects, how the defects may be detected, and also how they may be corrected.

The book is of particular value to the welding inspector for often he is in a position where he cannot obtain quickly competent opinions on his inspection problems.

Inspection Handbook for Manual Metal-Arc Welding. Paper bound, 6 x 9 in., 156 pages. Published by American Welding Society. Price, $1.50.

● ● ●

VAPORIZING POT-TYPE OIL BURNERS.—Effective from March 15, 1946, there will be adopted a new revised standard for warm air furnaces equipped with vaporizing pot-type oil burners. A mimeographed copy of this standard, TS-4077, is now available. Write to the Division of Trade Standards, U. S. Department of Commerce, National Bureau of Standards, Washington 25, D. C.

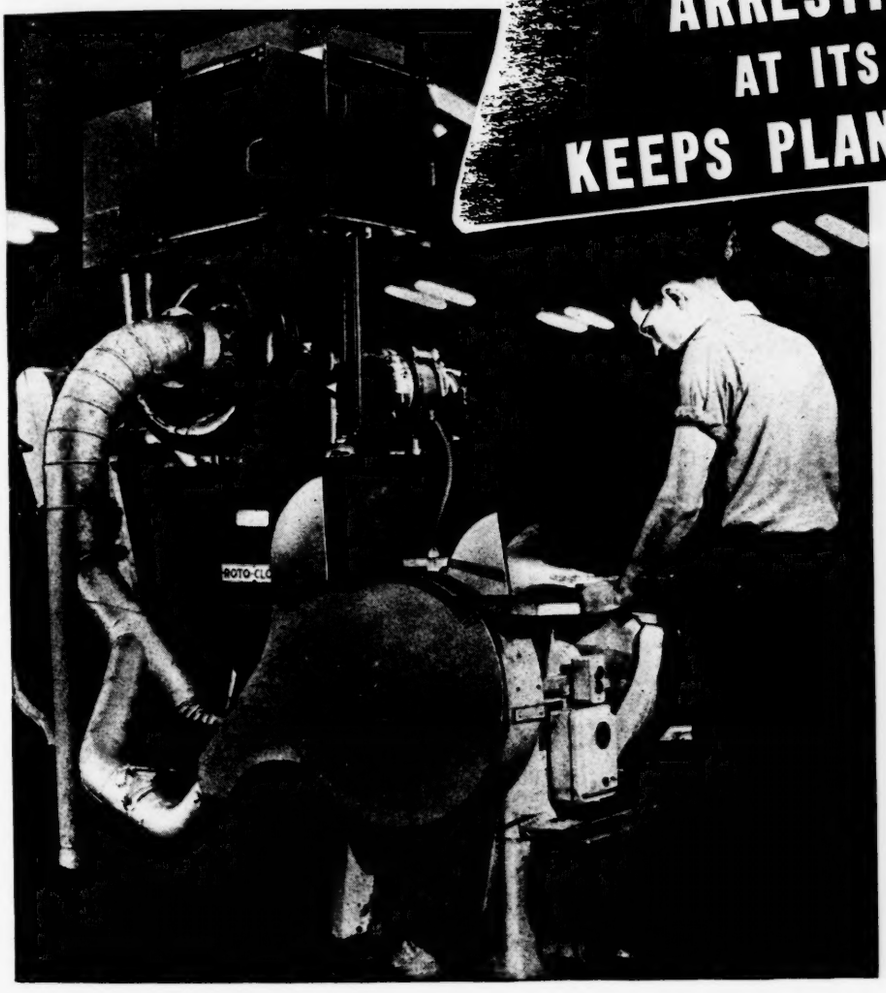
FAN AND BLOWER INDUSTRY TERMS.—An attempt has been made by the National Association of Fan Manufacturers to consolidate in one publication all of the standards generally recognized and accepted by the industry. This publication, an 11-page booklet, is termed Standards, Definitions and Terms in Use by the Fan and Blower Industry. Copies are available without charge by writing to the association at 5-208 General Motors Bldg., Detroit 2, Mich.

CHIMNEYS AND FIREPLACES.—Chimneys and fireplaces, the one a necessity of every home, and the other a luxury, and both a little-known part of the house to the average home builder, are the subject of a new free circular issued by the Small Homes Council at the University of Illinois.

The eight-page non-technical publication is liberally illustrated and warns that a chimney is difficult to remodel and should be built correctly the first time. The booklet tells how.

For instance, proportions must be correct if a smoky fireplace is to be avoided, and the flue must fit the fireplace. (Details and a table of dimensions are in the circular.) Built-in fireplace circulators can increase the heating capacity, but do not replace central heating systems. A spark-stopping screen is a necessity with a fireplace. Copies of the bulletin may be obtained from Small Homes Council, Mumford House, University of Illinois, Urbana, Ill.

ARRESTING DUST AT ITS SOURCE KEEPS PLANT AIR CLEAN



Above—One of 28 Roto-Clone Dust Control Systems in a windowless air conditioned factory. Exhaust air is filtered and recirculated through filter after cleaners mounted on top of the Roto-Clone unit.

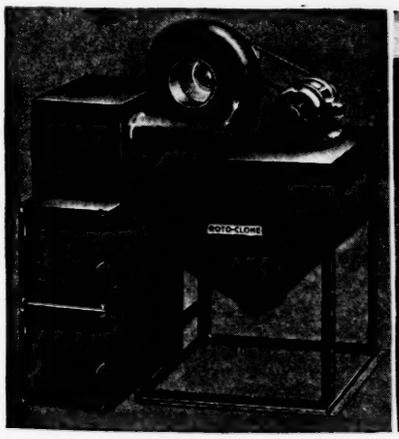
● Manufacturing operations involving the creation of dust have made efficient dust control a necessity in almost every industrial plant.

AAF has developed individual dust collecting Roto-Clone units in a wide range of sizes and capacities—some with filter after cleaners for air recirculation — that have had wide acceptance and approval.

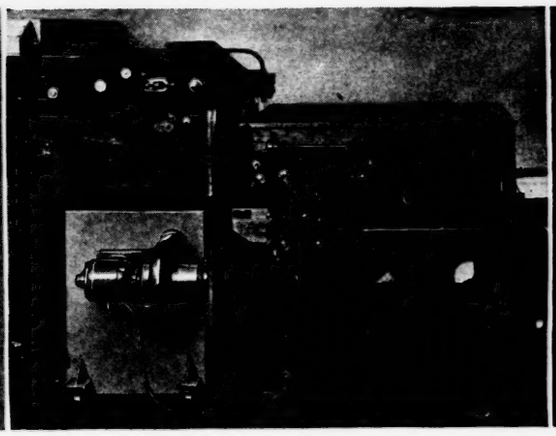
Shown on this page are several Type D Roto-Clones in operation—illustrating their adaptability to small space requirements. Complete information will be sent on request.

American Air Filter Co., Inc.
Incorporated
294 Central Avenue, Louisville 8, Ky.
In Canada: Darling Bros., Ltd., Montreal, P. Q.

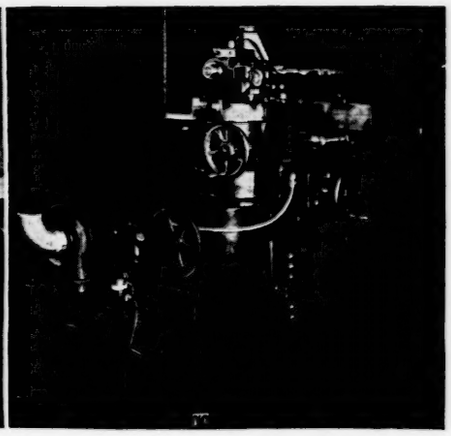
Below—Self-Contained Roto-Clone Unit controls dust from cutter grinder.



Roto-Clone unit with Filter after cleaner for recirculation of air.



Roto-Clone combined with Airmat Arrester solves dust problem created by Bronzing Machines.



ANOTHER AAF PRODUCT

ROTO-CLONE
Combined Exhauster and Dust Separator

Degree-Days for January, 1946

HEATING AND VENTILATING'S 19TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

CITY	JANUARY			CUMULATIVE, SEPTEMBER 1 TO JANUARY 31			HEATING SEASON[1]
	1946	1945	NORMAL	1945-46	1944-45	NORMAL	NORMAL
Abilene, Texas	698	613	326	1761	1668	1251	2061
Albany, New York	1265	1584	1287	3991	4208	3726	6580
Albuquerque, New Mexico	1651	875	924	5524	2644	2751	4298
Alpena, Michigan	1337	1565	1431	4296	4409	4382	8299*
Anaconda, Montana	1198	1194	1321	4394	4327	4492	8357**
Asheville, North Carolina	794	670	831	2605	2459	2520	4232
Atlanta, Georgia	657	683	682	1980	1997	1813	2890
Atlantic City, New Jersey	916	1107	992	2610	2872	2727	5176
Augusta, Georgia	489	546	555	1535	1587	1441	2161
Baker, Oregon	1211	1141	1218	4026	3780	4033	7163
Baltimore, Maryland	856	1072	955	2525	2796	2619	4533
Billings, Montana	1063	1169	1318	3955	3780	4134	7119
Binghamton, New York	1157	1504	1268	3708	4111	3783	6808
Birmingham, Alabama	618	683	589	1897	1843	1502	2352
Bismarck, North Dakota	1651	1556	1807	5524	4871	5321	9192
Block Island, Rhode Island	1001	1186	1048	2937	3126	2784	5788
Boise, Idaho	1114	1020	1097	3466	3272	3382	5552
Boston, Massachusetts	1133	1280	1150	3289	3452	3280	6045
Bozeman, Montana	1302	1220	1403	4555	4296	4689	8521**
Buffalo, New York	1166	1514	1240	3765	4023	3612	6822
Burlington, Vermont	1422	1703	1429	4397	4697	4202	7514
Butte, Montana	1304	1238	1309	4783	4567	4492	8272
Cairo, Illinois	819	971	908	2479	2573	2407	3909
Canton, New York	1463	1809	1520	4590	4943	4514	8020
Charles City, Iowa	1449	1560	1560	4643	4371	4455	7588
Charleston, South Carolina	440	488	487	1256	1358	1119	1769
Charlotte, North Carolina	670	722	725	2001	2116	1945	3120
Chattanooga, Tennessee	719	808	732	2235	2334	1957	3118
Cheyenne, Wyoming	1148	1134	1215	4023	3894	4104	7466
Chicago, Illinois	1137	1327	1274	3561	3733	3193	5957
Cincinnati, Ohio	910	1204	1017	2935	3257	2813	4684
Cleveland, Ohio	1109	1398	1181	3389	3647	3366	6155
Columbia, Missouri	998	1145	1110	3134	3132	3006	4922
Columbia, South Carolina	537	580	586	1623	1699	1502	2364
Columbus, Ohio	1016	1283	1113	3209	3443	3133	5398
Concord, New Hampshire	1420	1537	1349	4343	4425	4081	7353
Concordia, Kansas	995	1025	1184	3272	3032	3203	5315
Dallas, Texas	605	605	617	1572	1542	1487	2256
Davenport, Iowa	1202	1404	1352	3860	3758	3685	6289
Dayton, Ohio	1104	1347	1116	3510	3647	3063	5264
Denver, Colorado	954	968	1079	3215	3050	3355	5874
Des Moines, Iowa	1262	1357	1392	3920	3753	3762	6384
Detroit, Michigan	1141	1465	1252	3632	3870	3584	6490
Devils Lake, North Dakota	1825	1724	1949	6164	5269	5820	9970
Dodge City, Kansas	953	1013	1116	3009	2964	3068	5035
Dubuque, Iowa	1292	1479	1442	4145	4043	3976	6790
Duluth, Minnesota	1658	1728	1727	5445	5032	5216	9443
Eastport, Maine	1367	1399	1380	4223	4144	4270	8520**
Elkins, West Virginia	984	1233	1048	3384	3721	3265	5697
El Paso, Texas	742	594	629	1771	1684	1667	2428
Ely, Nevada	1363	1222	—	4432	4272	—	—
Erie, Pennsylvania	1066	1413	1172	3322	3530	3336	6273
Escanaba, Michigan	1421	1617	1550	4616	4600	4688	8771*
Evansville, Indiana	960	1096	949	2944	3032	2494	4244
Fort Smith, Arkansas	780	780	850	2201	2035	2027	3147
Fort Wayne, Indiana	1197	1456	1194	3818	4034	3405	5925
Fort Worth, Texas	621	595	580	1585	1526	1406	2148
Fresno, California	640	666	583	1565	1636	1494	2334
Galveston, Texas	360	320	353	754	742	683	1016
Grand Junction, Colorado	1203	1024	1233	3590	2959	3511	5548
Grand Rapids, Michigan	1175	1390	1262	3757	3820	3659	6535
Green Bay, Wisconsin	1434	1578	1538	4600	4403	4420	7825
Greensboro, North Carolina	787	849	772	2470	2576	2167	3529
Greenville, South Carolina	690	690	744	2118	2107	2078	3380
Harrisburg, Pennsylvania	1011	1227	1088	3143	3364	3069	5375
Hartford, Connecticut	1196	1390	1159	3653	3834	3316	6036
Hatteras, North Carolina	552	689	589	1449	1734	1316	2571
Havre, Montana	1216	1445	1624	4739	4641	4938	8700
Helena, Montana	1134	1194	1375	4350	4520	4433	7898
Houston, Texas	401	358	366	905	893	815	1157
Huron, South Dakota	1533	1469	1650	4905	4388	4735	8004
Indianapolis, Indiana	1050	1255	1128	3270	3384	3130	5298
Jackson, Miss.	539	583	—	1517	1518	—	—
Kansas City, Missouri	995	1061	1141	3092	2927	3007	4956
Kewanee, Illinois	1197	1370	1223	3653	3640	3534	6139
Knoxville, Tennessee	768	830	815	2353	2457	2298	3670
La Crosse, Wisconsin	1436	1552	1535	4721	4188	4313	7322
Lander, Wyoming	1269	1396	1436	4638	5033	4511	7947

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with nine exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, Sioux City, and Jackson, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill.; Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, and H. M. Ludlow, Box 1368, Jackson, Miss., respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table Concluded on page 102]

Smith MILLS BOILERS FOR RESIDENTIAL HEATING

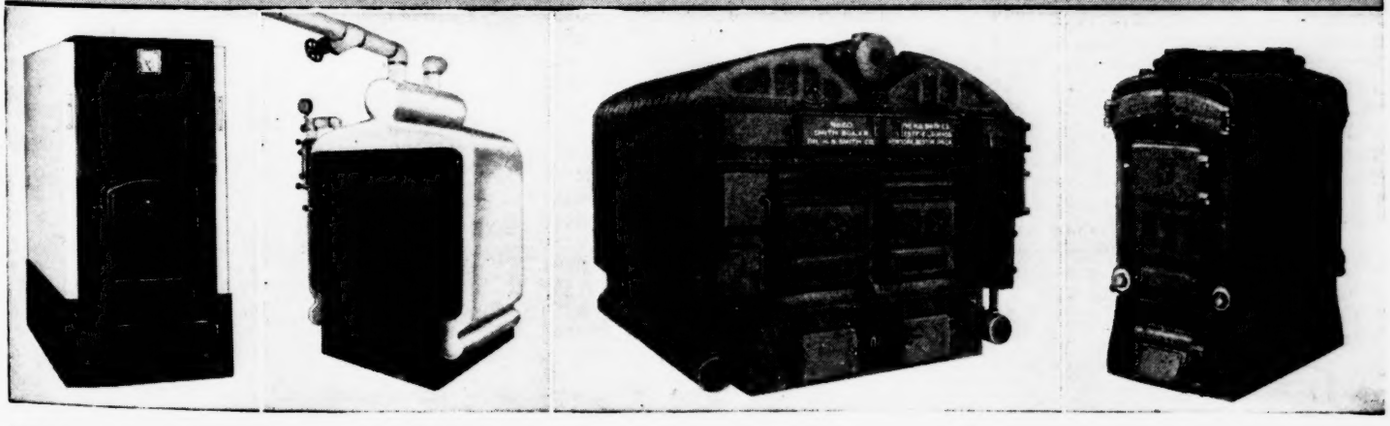
H.B. Smith
CAST-IRON BOILERS

HERE is a line of modern push nipple residential boilers that meets the exacting requirements of today's heating systems. Patterned after our famous "Mills" boilers, the "Fifteen," "Twenty," and "Twenty-five" SMITH-MILLS have the same vertical water tube design, the same efficiency of operation that have distinguished the performance of their big brothers.

Easy to assemble . . . fully convertible from one fuel to another . . . equipped with a complete range of built-in tank and tankless heaters . . . full provision for all automatic controls . . . These and many other features make SMITH-MILLS boilers a safe bet for the architect or heating contractor who will be judged in the steady light of product performance.

THE H. B. SMITH COMPANY, INC. • WESTFIELD, MASS.

Offices and Sales Representatives in Principal Cities



Degree-Days for January, 1946 (Concluded)

HEATING AND VENTILATING'S 19TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

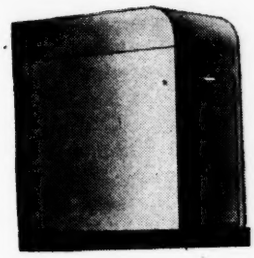
CITY	JANUARY			CUMULATIVE, SEPTEMBER 1 TO JANUARY 31			HEATING SEASON[1]
	1946	1945	NORMAL	1945-46	1944-45	NORMAL	NORMAL
Lansing, Michigan	1230	1483	1336	4016	4240	4001	7048
Lewiston, Maine	1483	1539	1452	4524	4459	4289	7707
Lincoln, Nebraska	1113	1124	1311	3541	3349	3512	5999
Little Rock, Arkansas	726	751	719	2079	2048	1798	2811
Livingston, Montana	1091	1019	1220	3990	3943	3951	7205
Los Angeles, California	224	259	326	637	644	750	1504
Louisville, Kentucky	899	1070	939	2693	2875	2526	4180
Lynchburg, Virginia	863	963	856	2644	2841	2413	3980
Macon, Georgia	493	559	549	1579	1618	1446	2201
Madison, Wisconsin	1359	1561	1500	4396	4285	4258	7429
Marquette, Michigan	1408	1565	1500	4603	4495	4554	8693*
Memphis, Tennessee	744	797	744	2164	2186	1871	2950
Meridian, Mississippi	539	588	552	1534	1618	1435	2160
Milwaukee, Wisconsin	1307	1476	1383	4059	4100	3984	7245
Minneapolis, Minnesota	1544	1621	1609	4876	4422	4550	7850
Modena, Utah	1133	1105	1187	3703	3638	3859	6562
Montgomery, Alabama	487	529	515	1452	1355	1284	1884
Nantucket, Massachusetts	994	1133	1026	2919	3046	2938	5957
Nashville, Tennessee	793	900	812	2425	2499	2175	3507
New Haven, Connecticut	1122	1294	1110	3395	3555	3219	5895
New Orleans, Louisiana	336	334	332	846	775	735	1024
New York, New York	963	1228	1060	2859	3127	2909	5347
†Nome, Alaska	1908	1670	1857	5387	4992	5236	14580**
Norfolk, Virginia	681	843	738	1945	2178	1933	3350
North Head, Washington	652	594	725	2556	2164	2510	5452**
North Platte, Nebraska	1034	1096	1300	3612	3502	3786	6366
Oakland, California	556	551	527	1612	1580	1626	3143**
Oklahoma City, Oklahoma	798	790	865	2231	2130	2244	3613
Omaha, Nebraska	1191	1243	1355	3793	3590	3639	6131
Oswego, New York	1216	1502	1277	3781	4060	3771	7088
Parkersburg, West Virginia	898	1171	992	2887	3270	2822	4775
Peoria, Illinois	1170	1398	1283	3802	3794	3606	6109
Philadelphia, Pennsylvania	926	1188	1001	2724	2976	2736	4855
Phoenix, Arizona	424	405	409	1045	979	990	1405
Pittsburgh, Pennsylvania	956	1254	1054	3056	3333	3003	5235
Pocatello, Idaho	1319	1149	1218	4154	4009	3867	6655
Portland, Maine	1401	1516	1321	4319	4333	3926	7218
Portland, Oregon	695	699	806	3338	2277	2530	4469
Providence, Rhode Island	1083	1255	1116	3196	3338	3246	6015
Pueblo, Colorado	1042	1079	1060	3404	3262	3224	5514
Raleigh, North Carolina	705	784	722	2090	2267	1975	3234
Rapid City, South Dakota	1128	1196	1320	4039	3910	4021	7118
Reading, Pennsylvania	993	1260	1088	3016	3288	3102	5389
Red Bluff, California	594	605	—	1644	1560	—	—
Reno, Nevada	974	989	1042	3240	3299	3326	5892
Richmond, Virginia	809	930	831	2373	2507	2211	3695
Rochester, New York	1202	1542	1252	3846	4187	3666	6732
Roseburg, Oregon	704	649	744	2250	2228	2485	4428
Roswell, New Mexico	822	689	786	2194	2156	2296	3484
Sacramento, California	591	630	614	1545	1599	1610	2653
St. Joseph, Missouri	1082	1135	1187	3352	3151	3147	5161
St. Louis, Missouri	936	1124	1060	2912	2972	2798	4585
Salt Lake City, Utah	1182	939	1110	3565	2971	3259	5555
San Antonio, Texas	496	424	381	1120	1159	854	1202
San Diego, California	275	301	332	687	697	819	1645
Sandusky, Ohio	1084	1402	1181	3367	3667	3323	6208
San Francisco, California	424	458	465	1305	1344	1414	3264**
Sault Ste. Marie, Michigan	1521	1793	1581	5015	5065	4828	9285**
Savannah, Georgia	376	412	409	1161	1155	1007	1490
Scranton, Pennsylvania	1093	1430	1387	3468	3895	3740	6129
Seattle, Washington	675	637	781	2402	2190	2650	4934**
Sheridan, Wyoming	1160	1244	1431	4117	4007	4629	8008
Shreveport, Louisiana	572	597	555	1522	1547	1324	1938
Sioux City, Iowa	1332	1315	1435	4331	3959	4018	6898
Spokane, Washington	1061	1002	1172	3708	3463	3755	6355
Springfield, Illinois	1049	1259	1181	3299	3761	3183	5373
Springfield, Missouri	944	1021	973	2921	2889	2647	4428
Syracuse, New York	1228	1568	1277	3875	4200	3768	6893
Tacoma, Washington	721	684	812	2662	2455	2763	5181**
Terre Haute, Indiana	1034	1195	1070	3202	3282	2910	4872
Toledo, Ohio	1151	1496	1203	3709	4053	3392	6077
Topeka, Kansas	981	1039	1135	3092	2899	3018	4969
Trenton, New Jersey	970	1240	1014	2939	3237	2774	4933
Utica, New York	1233	1606	1248	4088	4492	3785	6796
Valentine, Nebraska	1148	1246	1370	4040	4059	4095	7039
Walla Walla, Washington	795	835	989	2759	2795	2898	4808
Washington, D. C.	863	1062	970	2593	2839	2711	4626
Wichita, Kansas	930	956	1094	2877	2691	2877	4673
Williston, North Dakota	1549	1549	1805	5580	4887	5463	9323
Winnemucca, Nevada	1068	1123	1150	3543	3642	3739	6427**
Yakima, Washington	954	951	1159	3228	3113	3587	5599

†Nome data are for December.

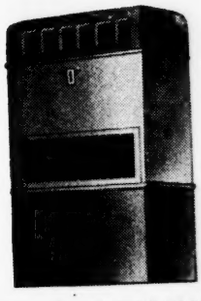
*Includes August.
**Includes July and August.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

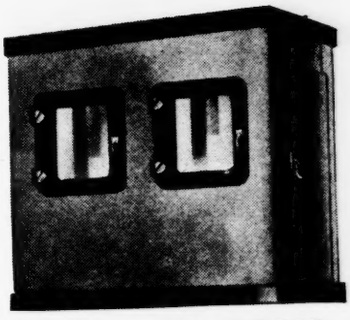
SPECIFY WHITE-RODGERS CONTROLS FOR...



HEATING

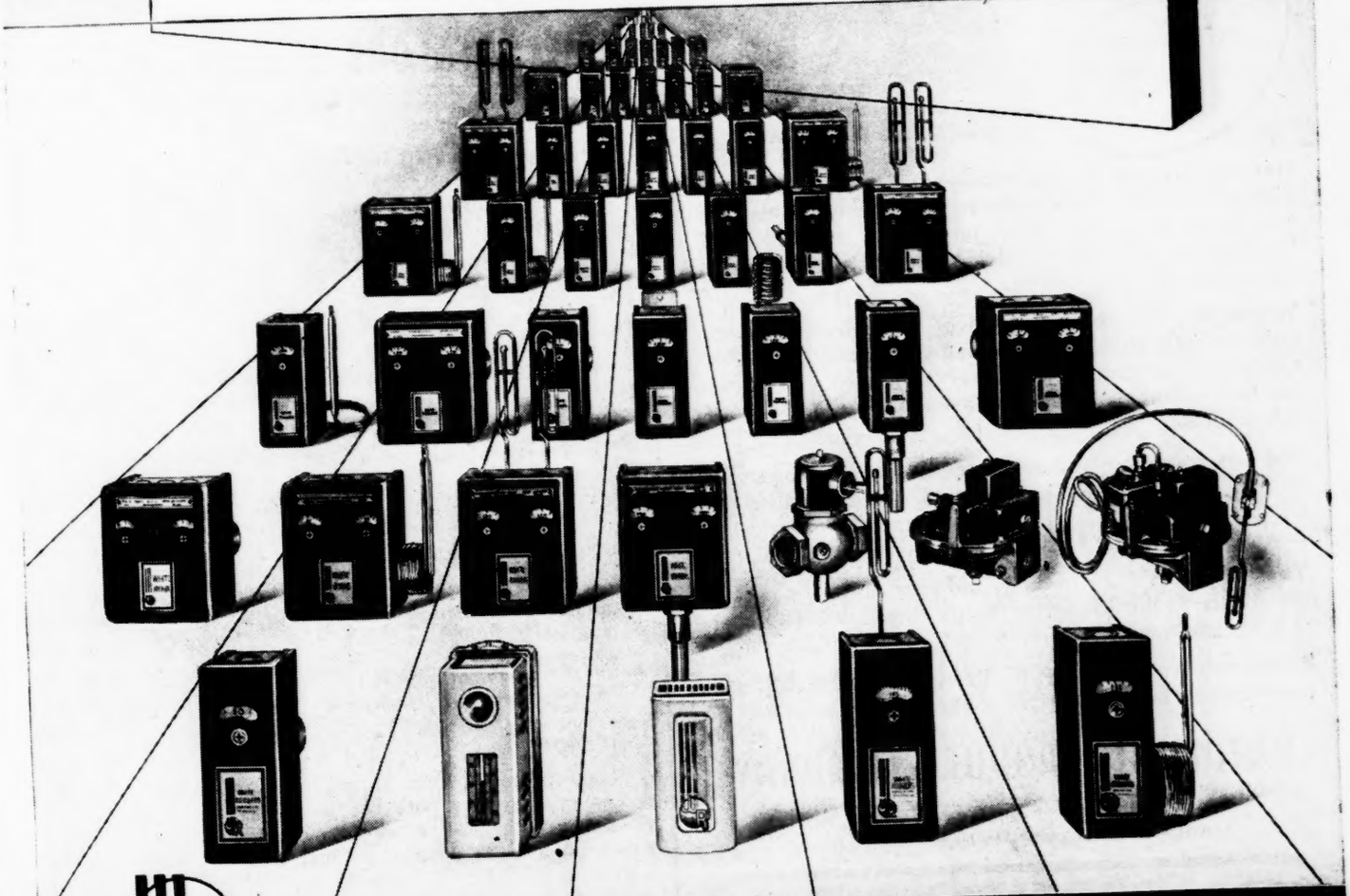


AIR-CONDITIONING



REFRIGERATION

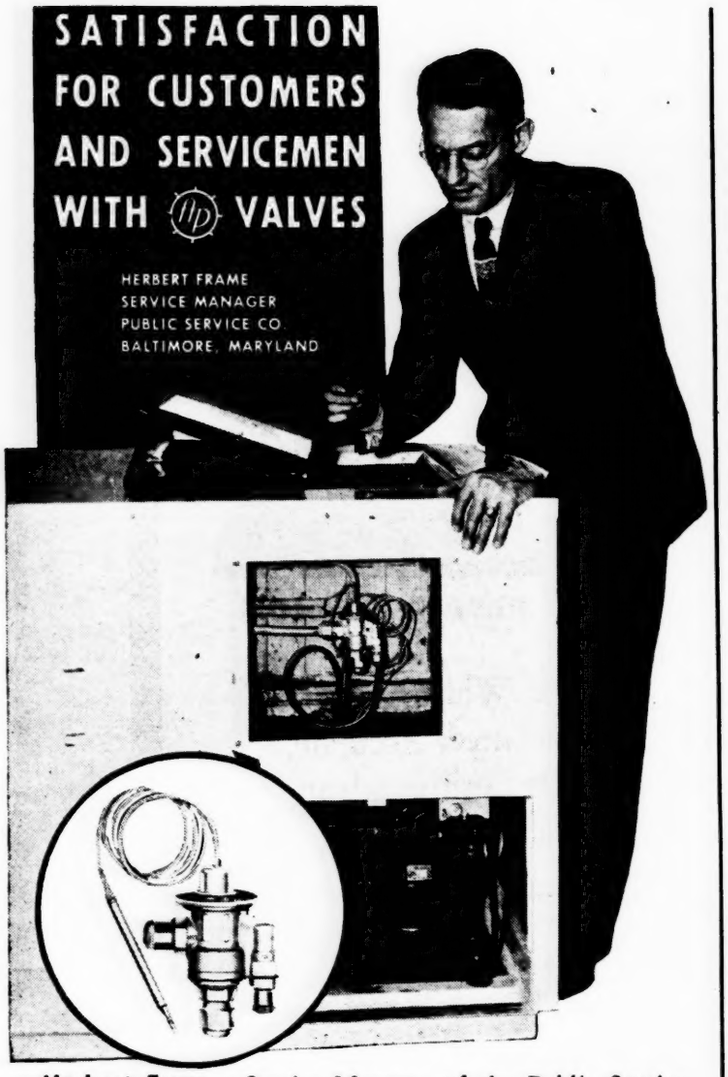
Whatever the application, the complete line of White-Rodgers temperature and pressure controls will meet your need. Accurate, readily installed, compact and attractive; put these positive advantages of White-Rodgers controls to work for you. Write today for catalog and installation data.



WHITE-RODGERS ELECTRIC CO.

ST. LOUIS 6, MISSOURI

Controls for Refrigeration • Heating • Air Conditioning



Herbert Frame, Service Manager of the Public Service Co., of Baltimore, shown above, is checking the temperature of an ice-cream cabinet on test. A standard "A-P" Thermostatic Expansion Valve Model 207 is used on this job as standard equipment.

Writes Mr. Frame: "A-P Valves for high and low temperature work have been used by our company since 1936. Customers' satisfaction as well as servicemen's satisfaction has been accomplished by the use of A-P Valves during this period."

There is more profit for servicemen and customers alike — with standard A-P Thermostatic Expansion Valves that can be used on low temperature, commercial temperature, and air conditioning work without adjustment.

You have less stock to carry, and your customers get better service — the kind that keeps them your customers year in and year out.

Bulletins covering all "A-P" Refrigeration Controls will be sent you upon request

AUTOMATIC PRODUCTS COMPANY

2462 North 32nd Street, Milwaukee 10, Wis.
Export Dept. 13 E. 40th St., New York 16, N. Y.

DEPENDABLE *Refrigerant Valves*

Stocked and Sold by Good Refrigeration Jobbers Everywhere
Recommended and Installed by Leading Refrigeration Service Engineers

Getting Personal

R. T. Gillette

R. T. Gillette *(Resistance Welding of Sheet Metal,* page 76) a member of General Electric Co. Works Laboratory at Schenectady, N. Y., has devoted considerable study to resistance welding.

He joined G. E. in 1902 as a member of the Research Laboratory. During World War I he was in charge of manufacturing operations of x-ray units for field hospitals abroad. He was instrumental in the development of electric furnace brazing at the company and won the coveted Charles A. Coffin Foundation Award for his work on welding dissimilar metals with the use of Elkonite electrodes. Mr. Gillette developed a brazing process for the first steel shaft golf clubs made in this country.

For the past 20 years Mr. Gillette has been engaged in resistance welding research, and he holds a number of important patents on brazing and welding.

He is a member of the Resistance Welding Executive Committee and the Resistance Welding Standards Committee of the American Welding Society. He is also a member of the Executive Committee, Resistance Welding Research Committee, Welding Research Council, and A.I.E.E.

NEW CATALOGS

Welding Machines

A 16-page booklet illustrating the Bumblebee line of alternating current arc welding machines shows power consumption, applications, specifications and electrical characteristics.—*Air Reduction, 60 East 42nd St., New York 17, N. Y.*

Insulation

A 27-page design and application data booklet written for insulated equipment manufacturers and showing procedures for insulating refrigerators, boilers, water heaters, ovens, railway cars, etc.—*Owens-Corning Fiberglas Corp., Toledo 1, Ohio.*

Refrigeration Equipment

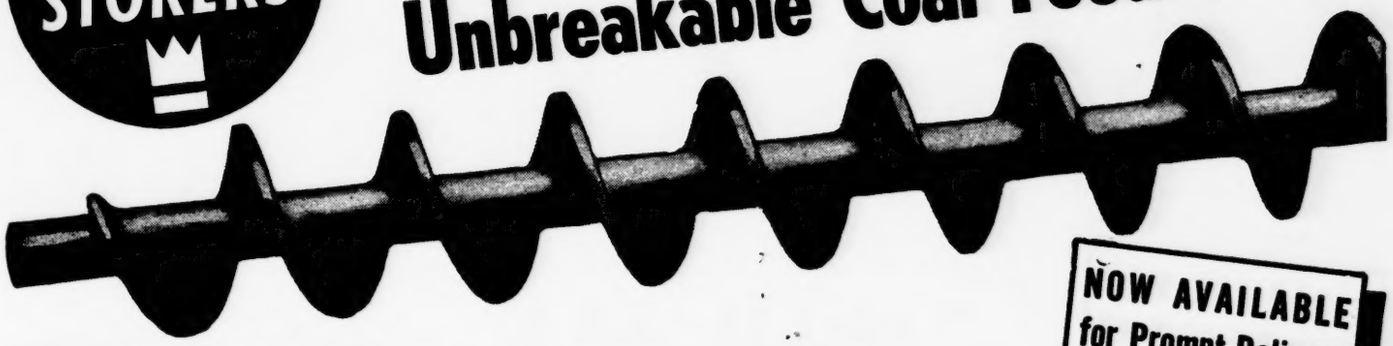
A 32-page booklet giving details and specifications of compressors, condensers, coolers, coils, valves, and fittings as well as complete air conditioning systems.—*Frick Co., Waynesboro, Pa.*

Insulation

"Insulation and Your Home," an informative handbook, is designed to give both the home-owner and members of the building trades a practical understanding of mineral wool insulation, its uses, its forms, its methods of installation, its heat and fire-resistant properties, its endurance, its advantages and other points of importance. It provides yardsticks to determine relative comfort and economy rating, and savings in fuel costs achieved by various thicknesses of installation, and is available without charge to engineers, architects, draftsmen, builders and contractors, who request it on their business letter-heads.—*National Mineral Wool Assn., 1270 Sixth Avenue, New York 20, N. Y.*

For STOKERS

The CROWN Unbreakable Coal Feed Screw



NOW AVAILABLE for Prompt Delivery

WELDED All-Steel Worm—All Sizes—All Pitches

★Crown's complete line of all-steel Coal Feed Screws meets every replacement and production requirement. Produced for both domestic and industrial stokers. Crown Screws are available with right or left hand screw, in all sizes and pitches, tapered or straight, and in combinations of pitches. Uniformly smooth surfaces insure that coal will flow freely and easily through the flights. Because it is all-steel with continuous weld, the Crown Coal Feed Screw guarantees long, continuous operation with full customer satisfaction. Crown is in a position to make prompt delivery on all sizes.

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TYPE R AGITAIR for

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Draftless, quiet diffusion of air, proportioned to any shape of room is easy with Type R Agitairs. The multi-orifice design dissipates initial velocity and temperature differential more rapidly. Quickly and easily installed. Attractive.

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Type R diffusers need not be located centrally within the space served. You can select a pattern that will serve any space from any location. We call it "Diffusion Pattern Control." Write Air Devices, Inc. today for more facts about Type R Diffusers—one of the many Agitair products for conditioned air. 21-A

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no rinsing . . . less rubbing high gloss . . . low cost

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Just moisten rag in solution of Oakite Renovator, wipe down surfaces of motors, turbines and generators . . . then dry polish for final bright lustre! Folks are calling this new Oakite technique "jiffy cleaning" because Oakite Renovator thoroughly emulsifies oil, grease and dirt, restores original high finish so rapidly! Try it today! Does not deteriorate painted, lacquered or enameled surfaces even after long use. Easy to handle, its high-dilution ratio means economical cleaning. Also gives exceptional results on painted wood surfaces. Write NOW for complete details.

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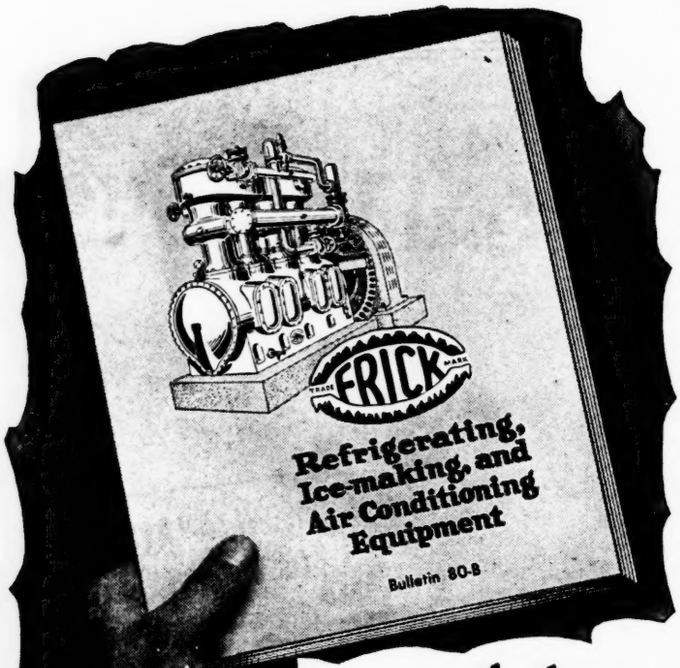
MATERIALS · METHODS · SERVICE · FOR EVERY CLEANING REQUIREMENT



Get the latest data—write for this book!

This new 32-page Catalog, containing over 150 photographs, diagrams, and tables, gives the very latest data on cooling systems of all commercial and industrial (not household) types.

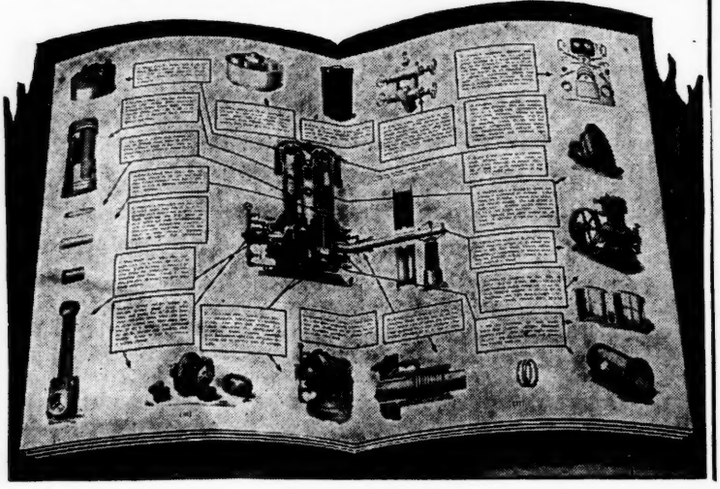
The Bulletin is printed in three colors, in full letter size, and has a durable cover. As shown below, it is one of the most informative books ever published on refrigerating machinery.

If you need such equipment, ask for your copy of Bulletin 80-B today. In writing please describe carefully the cooling work you wish to do.

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA. U.S.A.



Water Level Controls

A loose-leaf binder describing a line of precision level controls for boiler feed water and showing accessory thermometer wells. Specifications and price list are included.—*J. A. Campbell Co., 645 E. Wardlow Rd., Long Beach, Calif.*

Corrosion Engineers

A 4-page bulletin describing the services of a firm of engineers who recommend and install corrosion resisting linings for air conditioning equipment, tanks, and ducts.—*Industrial Lining Engineers, Inc., Edgeworth, Pa.*

Pipe Line Filters

An 8-page folder describing the Staynew line of pipe line filters for air and other gases with sizing tables and illustrated installations.—*Dollinger Corp., 11 Centre Pk., Rochester 3, N. Y.*

Instruments

A new post-war general catalog entitled, Specification Index for Bristol Instruments. The catalog, No. W1800, contains twenty-four pages of information on the Bristol line of automatic controlling, recording, and indicating instruments and gives hints on how they can be used effectively to save time, and money and promote efficient operation. Specification data are given on each instrument listed. The booklet is liberally illustrated with line drawings, which show basic methods of applying various types of industrial instruments.—*The Bristol Co., Sales Promotion Dept., Waterbury 91, Conn.*

Pumps

Sixty types and styles of vertical and horizontal pumps manufactured by Peerless Pump Division of Food Machinery Corp., are presented in a new bulletin (B-136) just issued by the concern. Types include deep and shallow well pumps, Hi-Lift pumps, and domestic water systems.—*Peerless Pump Division, Food Machinery Corp., 301 West Avenue 26, Los Angeles 31, California.*

Underwater Welding

A ten-page booklet on underwater cutting and welding describes the arc-oxygen process for the cutting of steel under water and for cutting cast iron and high alloy steels in the open air and gives working data and procedure information.—*Metal & Thermit Corp., 120 Broadway, New York 5, N. Y.*

. . . Since the Last Issue

Penn Electric Switch Co., Goshen, Ind. announces the appointment of **E. A. Price** as manager of the company's Dallas branch office at 302 Wilson Bldg. A graduate of the University of Minnesota with a degree in electrical engineering, Price was a sales engineer at Penn's home office from March, 1937, to September, 1941, when he was commissioned an Ensign in the U. S. Naval Reserve.

The Crocker-Wheeler Division of Joshua Hendy Iron Work, Ampere, N. J., has announced the appointment of **I. C. Smith** to the position of chief engineer of the company.

Pan American Alloys, Inc. of New Orleans, Louisiana, manufacturers of aluminum alloy castings, have purchased the buildings formerly operated by the National Machine and Foundry Company at Scottdale, Pennsylvania.

Steering a STRAIGHT COURSE IN THE STOKER BUSINESS

If you want to get into the stoker business in the BEST WAY, sell a stoker with a proven record of performance over a long period of years . . . a stoker praised by thousands of satisfied users, built by an experienced Stoker manufacturer, a 79-year-old company that knows how to help its dealers win profits.

AGAIN "Stoker Sales are Blowing a Gehl."

GEHL STOKERS

are well-known in the domestic, commercial, and industrial field for economical, trouble-free performance. The friendly "family" relationship between Gehl and its dealers encourages steady growth and continually growing sales and profits.

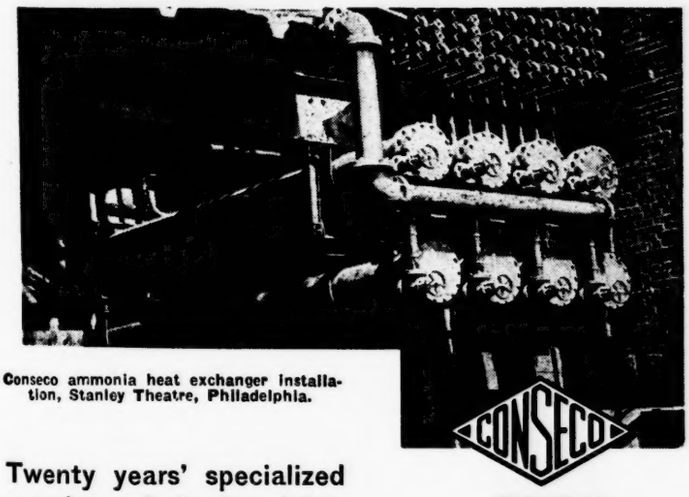
FIND OUT about the extra values offered in Gehl Stokers, and the fine program of dealer cooperation. WRITE today for literature and details.

Domestic and industrial models now available.

GEHL BROS. MFG. CO.

Dept. BC 860. Established 1867, West Bend, Wisconsin

A GEHL WINS FRIENDS WHEREVER IT GOES



Conseco ammonia heat exchanger installation, Stanley Theatre, Philadelphia.

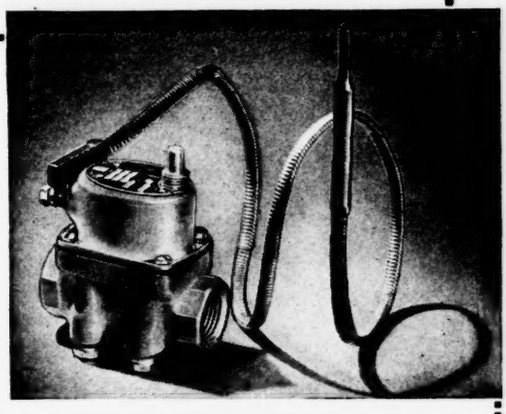
Twenty years' specialized experience designing, fabricating and servicing heat exchangers assure sound design, quality construction and economical operation with any type refrigerant. Engineering assistance gladly furnished. Write.

HEAT EXCHANGERS for Air Conditioning

CONDENSER SERVICE & ENGINEERING CO., INC.

63 RIVER STREET, HOBOKEN, N. J. • *Phone Any Time*

New MR-2 SAFETY THERMOVALVE



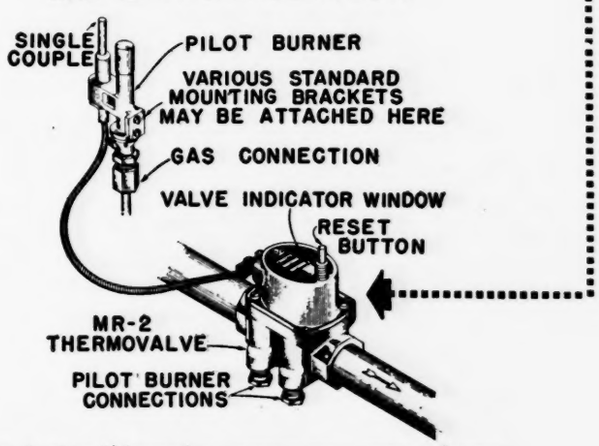
THIS new electro magnetic thermovalve assures unfailing safety in gas control applications. Used on space and unit heaters, central and floor furnaces, water and range heaters, hot water and steam boilers. Handles manufactured, natural or LP-Gases.

Check these outstanding features:

- Streamlined design.
- High-flow capacities.
- Visual valve position indicator.
- Design simplicity.
- Sealed electro magnetic assembly.
- Heavy duty 5/16 round thermocouple.
- Flexible armored cable leads.

On the diagram below, the new MR-2 valve and the new 26-R Pilot Burner are used for out-pilot safety control. No outside current is required. Valve holds open until released by pilot-flame failure. 100% gas shut-off will be maintained until pilot light is reignited and valve manually reset by push button.

MR-2 INSTALLATION



For further information, contact your nearest factory branch or distributor, or write for Catalog 52-B and Manual FI-101.

GENERAL CONTROLS

801 ALLEN AVENUE GLENDALE 1, CALIF.

FACTORY BRANCHES: PHILADELPHIA • ATLANTA • BOSTON • CHICAGO • DALLAS KANSAS CITY • NEW YORK • DENVER • DETROIT • CLEVELAND • PITTSBURGH HOUSTON • SEATTLE • SAN FRANCISCO • DISTRIBUTORS IN PRINCIPAL CITIES

15-2

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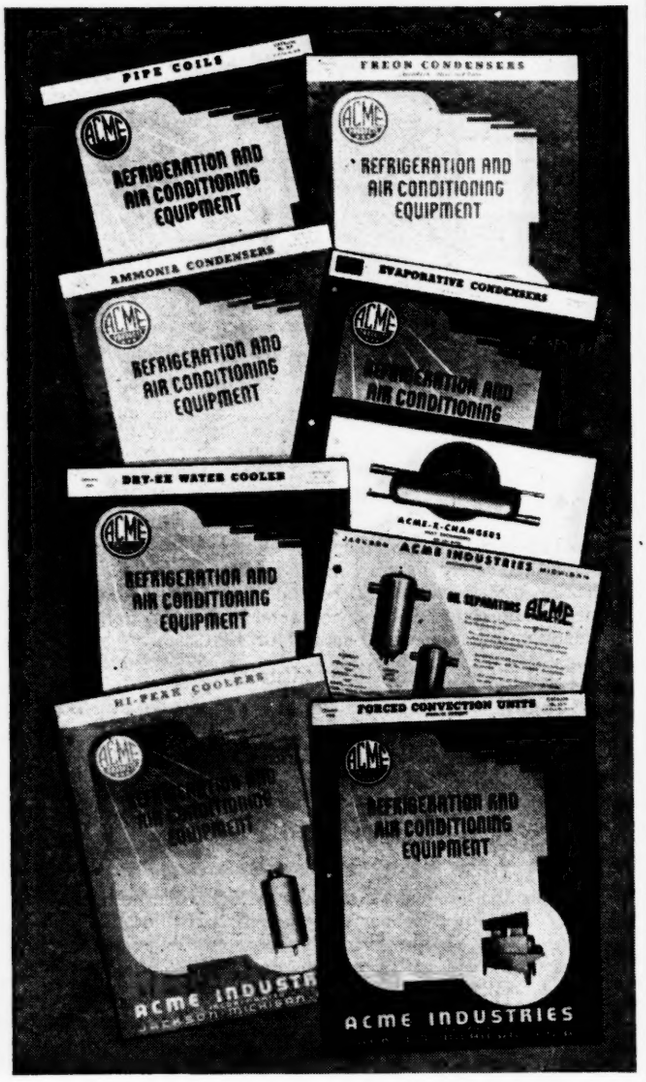
The Acme line is so complete?



Complete New Set of Catalogs

. . . write for the ones you need

You may already have an Acme catalog or two—but do you have all the Acme catalogs completely describing the various pieces of refrigeration and air conditioning equipment in the entire Acme line? Write for complete information on any equipment you may not already know about.

ACME INDUSTRIES

Refrigeration and Air Conditioning Equipment

Jackson • Michigan

D. J. Mosshart has been appointed engineering manager of the **Westinghouse Electric Corp.** Steam Division at Philadelphia. Westinghouse has obtained 19 patents on Mr. Mosshart's inventions, six of which are in general use, including improvements upon a three-roll clinker grinder and a multiple-secondary ram. He succeeds R. A. Foresman, who had been on extended service for several months prior to his retirement.

The appointment of **Edgar P. Hollister** as manager of the New York Factory Branch was recently announced by Mr. J. F. Ray, director of sales, **General Controls Co.**, Glendale, California. Mr. Hollister will devote his entire time to serving users of automatic pressure, temperature and flow controls in New York State, New Jersey and Connecticut.

Star Electric Motor Co. announces the opening of a New England district office at 1430 Massachusetts Avenue, Cambridge 38, Mass., on January 2, 1946. Elliot W. Knight has been appointed district manager. He is a graduate in Electrical Engineering of Rensselaer Polytechnic Institute and has had 10 years of application engineering.

Clarence A. Rundall has joined the sales department of **Airtemp Division, Chrysler Corp.**, as assistant director of heating sales. A native of Yonkers, N. Y., he will make his headquarters in Dayton. He has been associated with this industry for 19 years. the first 12 years with a stoker manufacturer in New York City, where he advanced from retail salesman to district manager. For five years he was special factory representative for a temperature-control device, serving stoker firms. For two years he had charge of all stoker sales and sales promotional work for a manufacturer of automatic stokers.

C. A. Rundall

Tube Turns, Inc., Louisville, Ky., has opened an office in Detroit, at 713 Ford Bldg., in charge of **Jack Ellsworth.** He will represent Tube Turns' forging and welding fittings divisions, and his territory will include Michigan, Northeastern Ohio, North Illinois, and most of Indiana. Before assuming his new post, he was assistant district manager of the Midwest territory, with headquarters in Chicago.

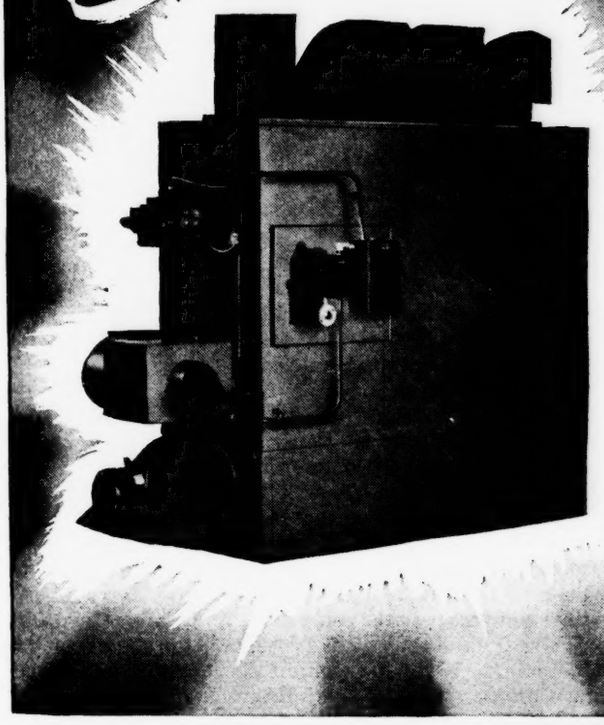
A native of Sutherland, Nebraska, Mr. Ellsworth attended the Wisconsin School of Mines and began his business career as an erection engineer for Fairbanks-Morse. He was a member of Ford's mechanical and structural engineering staff, in Detroit and Pittsburgh, and was with the Ellsworth Pine & Supply Co., Milwaukee, before joining Tube Turns in December, 1940.

Leonard K. Wright, Jr., Knoxville, Tenn., retiring from the U. S. Army Air Forces as a captain, will represent the **Alco Valve Co.**, St. Louis, as field engineer in the southeastern territory. Mr. Wright attended the University of Tennessee and in 1940 joined the Ansul Chemical Co., refrigerant manufacturers. He was district manager for Ansul in Des Moines, Iowa, at the time he entered the Army. He succeeds John B. Meyer in this Alco territory and will have offices at 508 Burwell Bldg., Knoxville.

Carrier Corp., has recently made a number of new assignments in its Engineering Division, including appointment of four Directors of Development. The four directors are **Sam F. Shawhan**, director of air conditioning development; **R. Wayne McLaughlin**, director of centrifugal refrigeration development; **J. Loren Fletcher**, director of package units development; and **Lars Hanson**, director of reciprocating refrigeration development.

Save Monthly Operating Costs

WITH THE NEW AIRTHERM DIRECT FIRED WARM AIR HEATER

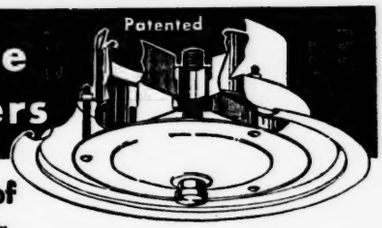


High efficiency and low operating cost are a major consideration in any heating application. Low internal resistance through the Airtherm Warm Air Heater requires a minimum of motor horsepower, per B.T.U. output, resulting in savings in power costs to the user.

Investigate the highly efficient Airtherm for meeting your factory heating requirements. Write for bulletin 801 which will be sent on request.

AIRTHERM
MANUFACTURING COMPANY
722 S. Spring Ave., St. Louis 10, Mo.

Adjustable Air Diffusers



Any desired condition at your fingertips

For better mixing of room and supply air, more uniform temperature throughout the occupied zone and noiseless air diffusion.

Kno-Draft Type K Adjustable Air Diffuser with Type D volume damper

Whether they are used in heating, cooling, ventilating or combined systems, Kno-Draft Adjustable Air Diffusers can be adjusted quickly and accurately for system balancing and individual or seasonal requirements. By simply turning the air adjustment screws (easily accessible from under the unit) the inner cone may be raised or lowered to secure any angle of air direction required. The built-in volume damper (regulated by the hand-turning knob) varies the air outlet aperture uniformly without affecting the outlet velocity or diffusion pattern.

Free handbook: contains clear sketches, charts, dimension prints and instructive text that simplify the selection and installation of air diffusers. Please write Dept. **E-13** for your copy, using your company letterhead.

W. B. CONNOR ENGINEERING CORP.
AIR DIFFUSION AIR PURIFICATION AIR RECOVERY
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Get Extra Profits out of Radiant Heating

with
Tal's Portable, Hydraulic Bender

• Bending pipe on the job is making **more money** for those contractors alert enough to get behind radiant heating with the right equipment—a Tal portable pipe bender. This best engineered machine bends cold to any angle all wrought iron or steel pipe ⅜" to 3" in one single, fast moving operation. It reduces the need for welds by from 40% to 80% — speeds up installation work. Used now by leaders who know it repays its low cost many times a year. Write for bulletin

Tal's Prestal Bender, Inc.
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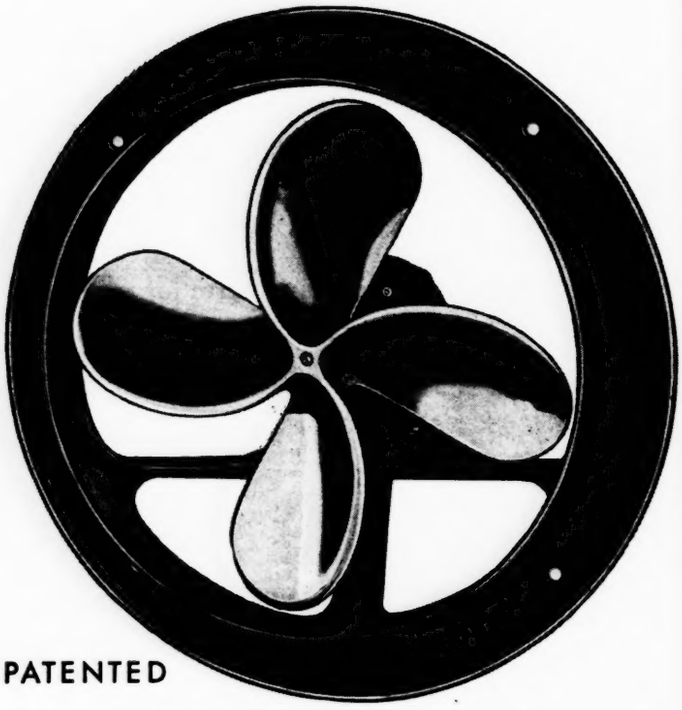
KEEP IT QUIET

WITH

Stilphen

FANS



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Design of Stilphen "Stil-Blade" Exhaust Fans makes them ideal for tough exhausting jobs where top notch equipment is required. They're built to move large volumes of air in a straight line quietly, uniformly and with high efficiency.

Fan wheels operate without dead centers, eddy currents and air friction. A smooth, uniform flow of air over the entire surface of the fan blade assures silent, economical operation and the most positive performance attainable.

All fan blades are of aluminum-copper alloy, cast in one piece to eliminate the chance of the blades working loose to throw the fan out of balance or cause accidents. Fan and motor are mounted in cast iron support ring, cast in one piece for long, dependable service life. All types and sizes of these fans are available for horizontal or vertical operation.

Act now! Incorporate Stilphen "Stil-Blade" Fans in your products for better performance and more economical operation. There's a size and type fan to fit every type exhausting installation.

In addition to Stilphen "Stil-Blade" Exhaust Fans, Howry-Berg manufactures Hot Water Pumps and Evaporative Air Conditioning Units.

Write for product bulletin. Howry-Berg Steel & Iron Works, 2949 N. Speer Blvd., Denver 11, Colorado.

Territories open for Distributors

HOWRY-BERG

To provide enlarged and more adequate facilities with which to meet the expanding requirements for its production, engineering, research and administrative activities, **Modine Manufacturing Co.** has started construction of a half-million dollar addition to its Racine plant. The new building which will be joined to the south end of the present structure, will provide approximately 65,000 additional sq ft of floor area. Approximately 35,000 sq ft of modern manufacturing space will be gained in the presently existing structure as a result of moves made possible by the addition of the new unit.

Eugene D. Milener has been appointed coordinator of general research of the **American Gas Association** effective March 1. At the same time, **Mahlon A. Combs** was promoted from assistant secretary of the Industrial and Commercial Gas Section to secretary, succeeding Mr. Milener in this post.

E. D. Milener

Mr. Milener's new duties consist of coordinating the general and technical utilization research of the association. In this capacity, he will continue to serve as secretary of the Coordinating Committee on Research, the Domestic Gas Research Committee and the Industrial & Commercial Gas Research Committee. It will be recalled, in this connection, that Mr. Milener was the originator of the concept of the degree-day. Coordination of Gas Production Research continues to be directed by Edwin L. Hall.

The new secretary of the Industrial and Commercial Gas Section, Mr. Combs, has had 25 years' experience in the gas industry. He became assistant secretary of the Industrial and Commercial Gas Section last September.

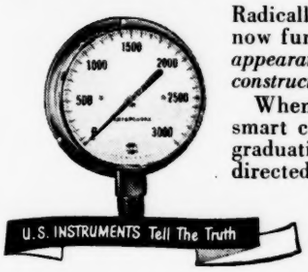
Edward Drew, formerly deputy manager, American Bankers Association, will join the American Gas Association as assistant director of promotion.

Albert O. Vogel, formerly lt. commander USNR, has returned to **The Vilter Mfg. Co.,** Milwaukee manufacturer of industrial and commercial refrigeration and air conditioning equipment, where he was appointed assistant to the president. Mr. Vogel has returned to Vilter after a leave-of-absence of forty months. A graduate of Cornell University, Class of 1923, Mr. Vogel is also a member of American Society of Refrigeration Engineers, the University and Yacht clubs, as well as being a member of the board of directors of the Milwaukee Zoological Society.

Robert P. Quinn has been appointed assistant director of sales of applied and packaged air conditioning for **Carrier Corp.** He served for 3 years as a Major in the Army Air Forces. Before entering the service, Mr. Quinn was associated with Shook & Fletcher Supply Co., Carrier distributors in Birmingham, Ala.

H. T. Kucera announces the organization of **Automatic Devices Co.,** 53 W. Jackson Blvd., Chicago 4, Ill., of which he is president. The company will manufacture an outside thermostatic control for buildings. Mr. Kucera is the inventor of the Tritrol and until July, 1945 was vice-president of the Marsh Tritrol Co., in charge of sales.

G. F. Reznor, son of the founder, succeeds the late William M. Graham as president of the **Reznor Mfg. Co.,** Mercer, Pa. Mr. Reznor has been with the company for 40 years and is largely responsible for the engineering and design of Reznor heaters. Dave Webster moves up to vice-president and general manager.



Radically improved! Precise as always but now functionally styled to bring you new *appearance*...new *readability*...new *sturdier construction*.

When you consider the pleasing lines and smart colors . . . note the visibility of the graduations . . . the years of development directed toward bettering life, quality and durability...you'll say, "They're the gauges for equipment we buy, use, or sell!"

UNITED STATES GAUGE, SELLERSVILLE, PA.

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DIVISION OF AMERICAN MACHINE AND METALS, INC.
Manufacturers of Pressure, Temperature, Flow and Electrical Measuring Instruments

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PERMANENT
Industrial Filters

FOR IMPROVED AIR FILTERING
— GREATER CAPACITY —
LOWER MAINTENANCE COSTS

SPECIALLY DESIGNED for extra heavy duty and industrial air cleaning services, BADGER Heavy Duty Permanent Filters assure improved air filtering, lower air resistance, greater dust-holding capacity, while definitely reducing costs of maintenance. In addition, longer filter life is a certainty. Available in 2" and 4" sizes.

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331 E. Brown Street, Milwaukee 12, Wisc.

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building Dec. 31, 1946.
HOTELS PLANNING.
NEW YORK, N. Y. (AP) — Almost $1,500,000,000 will be spent to rehabilitate, re-equip and modernize 12,868 of the nation's hotels, J. E. Frawley, president of the American Hotel association, said Monday. He said expenditures would include $76,000,000 for air conditioning.

$76,000,000
HOTEL AIR-CONDITIONING
AND THE BEST OF THESE JOBS WILL USE..

Waterloo
AIR DIFFUSION EQUIPMENT

NEW CATALOG!

It's up-to-the-minute and complete — gives every detail and fully describes Waterloo Registers and Grilles.

Includes simplified grille selection data — so you can quickly determine grille sizes. Send for your free copy.

WATERLOO REGISTER DIVISION
ASSOCIATED MANUFACTURERS, INC.
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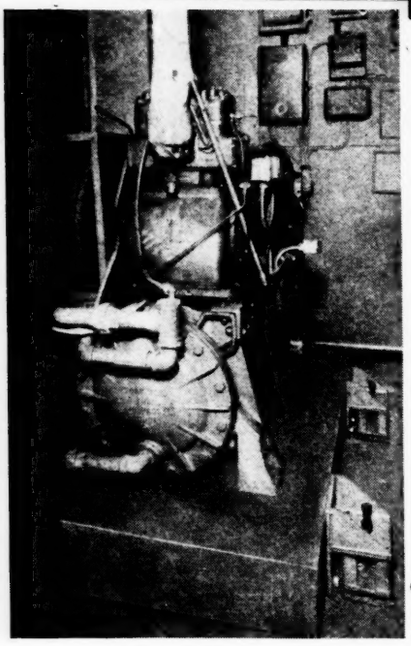
AIR CONDITIONING *Silenced* by KORFUND



Adjacent to a broadcasting studio on the eighth floor of a New York building, this 2-cylinder, 2050 lb. compressor unit with speed of 650 RPM, 10 HP motor at 1700 RPM, is installed on 1800 lb. concrete slab, and side-mounted on four Korfund LK/D Vibro-Isolators with Elasto-Rib pads. These support the entire unit with no disturbing vibration or noise transmission.

Everyone knows that broadcasting studios have to be quiet. And since most broadcasting studios today are air-conditioned, Korfund Vibration Control must keep air conditioning noises OFF THE AIR. Korfund meets this test of vibration and sound control with especially designed Vibro-Isolator Units.

Whether YOUR air conditioning is in a restaurant, department store, hospital or theatre, one of its benefits is quiet operation. Korfund Vibration Control is the answer to air conditioning operating disturbance. Contact Korfund today for a discussion of your vibration and noise transmission problem. No obligation, of course.

KORFUND
VIBRATION CONTROL
THE KORFUND COMPANY, Inc., 48-33 32nd Pl., LONG ISLAND CITY 1, NEW YORK

C. A. Dunham, founder of the **C. A. Dunham Co.** and president since its organization, relinquished the presidency on December 31, 1945 for reasons of ill health. He was succeeded by **H. S. Marshall,** for many years counsel and later vice-president. Associated with him are: **C. W. Neill,** 1st vice-president; **F. E. Schmidt,** 2nd vice-president; **C. H. Brigham,** 3rd vice-president; **A. R. Welker,** secretary and treasurer. On the same date Mr. Dunham was elected chairman of the board with the duty of advising as requested by the board. In 1903 the first commercial Dunham traps were made in a small basement shop in Marshalltown, Iowa. The following year the first Dunham factory came into existence with the erection of a wooden structure opposite the site of the present modern plant which was built in 1910, enlarged in 1913, 1917 and again in 1925.

L. N. Zimmerman, Howard B. Weeks and Gale B. Robinson have been appointed district representatives in the midwest and central division for the **Iron Fireman Mfg. Co.** Mr. Zimmerman will cover southeastern Michigan and

L. N. Zimmerman *H. B. Weeks* *G. B. Robinson*

northwestern Ohio with headquarters in Detroit. Mr. Weeks will have headquarters in Decatur, Illinois. He has been a member of the company since March, 1934. Mr. Robinson rejoins the organization after army provost marshal service.

L. E. Osborne, who joined Westinghouse at the age of 16 as a clerk in the tool room at the East Pittsburgh Works, recently was named senior operating vice-president of the **Westinghouse Electric Corp.,** responsible to the president for all manufacturing units of the company. In announcing the appointment, Gwilym A. Price, president, explained that Mr. Osborne's new responsibilities also include all subsidiary manufacturing companies as well as the District Manufacturing and Repair Department and the Headquarters Manufacturing Division of Westinghouse. His office is transferred to Pittsburgh.

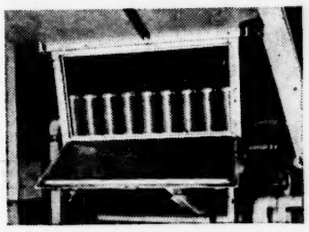
Carrier Corp., manufacturer of air conditioning and refrigeration, has entered into an agreement with **Tropic-Aire, Inc.,** a subsidiary of The Greyhound Corporation, whereby Tropic-Aire is to have exclusive rights, with certain exceptions, to sell Carrier air conditioning equipment for motor busses in the United States, it was announced.

Brooks Equipment Corp., makers of flexible equipment, has consolidated executive and sales offices, and production facilities at 217 Hudson St., Hoboken, N. J.

At the regular meeting of the **Resistance Welder Manufacturers' Association,** which was held in Detroit on January 24, the following officers were elected to serve during 1946: President, **H. B. Warren,** executive vice-president, Thomson-Gibb Electric Welding Co., Lynn, Mass.; vice-president, **G. N. Sieger,** president and general manager of S-M-S Corp., Detroit, Mich.; executive secretary, **George A. Fernley,** Philadelphia, Pa.; secretary-treasurer, **H. R. Rinehart,** Philadelphia, Pa.

You save fuel, power and equipment when you save conditioned air

All ventilation is essentially the dilution of stale, odorous and contaminated air. Fresh air for that purpose can be obtained by purifying already conditioned return air with Dorex *activated carbon* Air Recovery Equipment. This can be done at a cost materially lower than the cost of drawing in and conditioning the quantities of outdoor air otherwise required.



Dorex activated carbon canisters in air duct.
One of the 30 installations in the Criminal Courts Building, New York

The W. B. Connor Engineering Corporation maintains a research laboratory, a staff of trained specialists and district representatives in leading cities whose services are at the disposal of Consulting Engineers, Architects, Air Conditioning Distributors and Plant Engineers. They will be glad to give you the details on actual savings in typical installations or estimate the savings on any existing or planned system.

For full information and quotations on Dorex Equipment, call the nearest District Representative or write Dept. **D-8.**

W. B. CONNOR ENGINEERING CORP.

AIR DIFFUSION AIR PURIFICATION AIR RECOVERY

112 East 32nd Street WB CONNOR **New York 16, N. Y.**

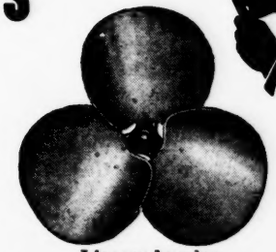
IMPROVE FAN PERFORMANCE

WITH

Meier Nu-air

TRADE MARK REGISTERED

Quiet PROPS

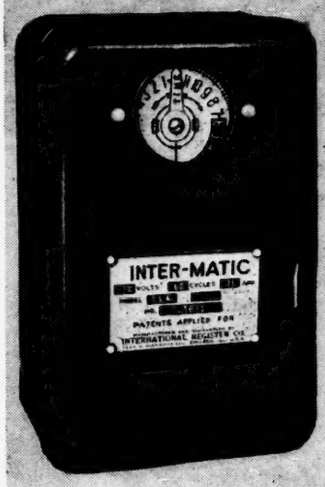


Licensed under Torrington Mfg. Co. Patents

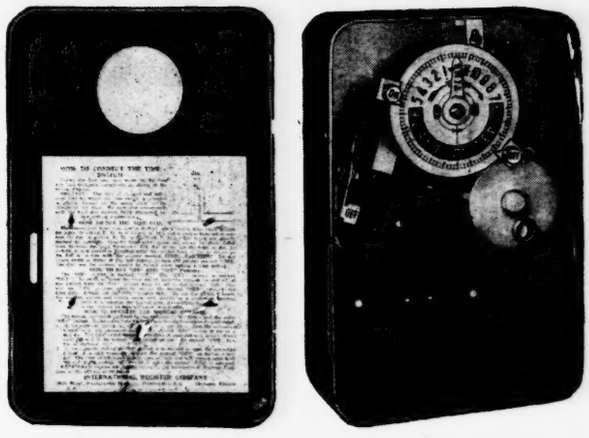
The manner of performance is what interests you in propeller blades. Quiet performance . . . first-rate air delivery with only a whisper of sound. Meier Nu-Air blades are insulated from the spider and hub . . . near-mirror finish aluminum; the spider is cadmium plated . . . all propellers are static balanced and guaranteed to be accurate. These are only a few of the qualities that help make Quiet Props mean quiet performance. Meier Nu-Air Props are available in sizes from 10" to 54" and pitch from 11° to 34°. For further details, write for Bulletin No. 2100.

Meier ELECTRIC & MACHINE CO.
3525 E. WASHINGTON STREET
INDIANAPOLIS, INDIANA

The INTER-MATIC TIME SWITCH is Well Engineered



DESIGN FEATURE No. 1
REMOVABLE DOOR



You CAN remove the door from the INTER-MATIC easily. It's only one of the many important features which make the INTER-MATIC a well designed unit.

WITH THE DOOR REMOVED

—You can mount the INTER-MATIC easier.

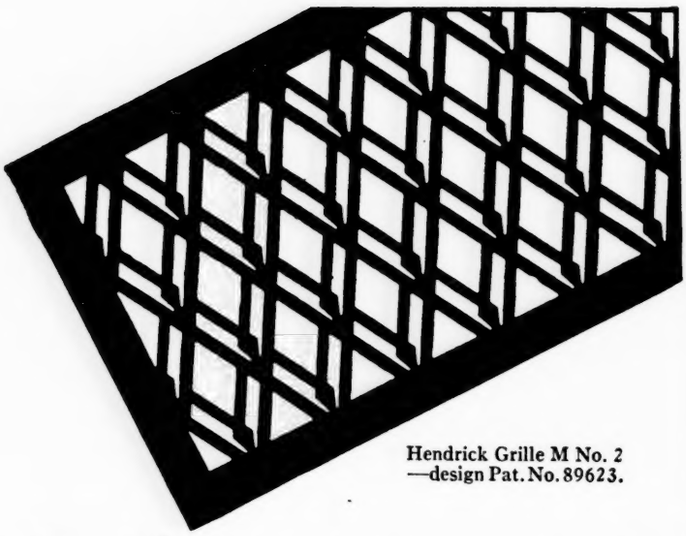
—You can set and reset the Timings more readily.

—You can make the wiring connections with less trouble.

WRITE FOR CATALOGUE AND NAME OF NEAREST DISTRIBUTOR.

$7.50 LIST
F.O.B. CHICAGO
115 V., 60 Cycle

INTERNATIONAL REGISTER CO.
Dept. 36D, 2624 W. Washington Blvd., Chicago 12, Ill.



Hendrick Grille M No. 2
—design Pat. No. 89623.

Why it pays to

SPECIFY

HENDRICK GRILLES

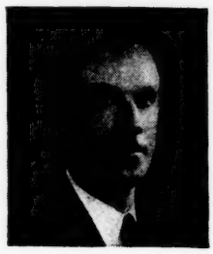
Decorative grilles by Hendrick possess maximum customer-pleasing beauty and utility – offer exceptional ease of installation because they always lie flat, due to a special flattening operation.

Dependability in such important details of manufacture and materials, has long been a keynote of Hendrick policy. Grilles are rugged and strong, made of heavy-gage metals – sizes are accurate, produced in flat or curved types and segments – perforations are clean-cut and free from imperfections – and varied designs are available in many commercially rolled metals. Write for your copy of the 194-page Hendrick Grille Handbook, which illustrates over 100 standard and exclusive designs, on your letterhead.

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and
Amorgrids.

HENDRICK
Manufacturing Company
42 DUNDAFF STREET, CARBONDALE, PA.
Sales Offices in Principal Cities

Russell W. Boettiger has been appointed sales manager of **Leslie Co.**, Lyndhurst, N. J., manufacturers of regulators, controllers and whistles. Mr. Boettiger, a graduate of mechanical engineering at Cornell University, joined the Leslie organization in 1936 as sales and service engineer. Prior to that he was in plant engineering with General Foods Corp. In 1942, he was appointed chief planning engineer in charge of coordinating production with the stringent requirements of the wartime shipbuilding program.



R. W. Boettiger

Roger D. DeWolf, past president of the **National District Heating Association** and a committee chairman of the National Electric Light Association from 1910 to 1930, died Feb. 2, at the age of 66.

Born in Toledo, Ohio, Mr. De Wolf was a graduate of Ohio State University. He was a member of the engineering and research staff of Western Electric in Pittsburgh from 1901 to 1909 and held supervisory positions with the Rochester Gas & Electric Corporation until 1930, afterward working for two years as supervising engineer for the Utilities Management Company in Reading, Pa. After operating his own furnace company in Rochester for ten years, he went to Kansas in 1942 to become chief construction engineer on the Sunflower Ordnance Plant built by du Pont interests with Government financing.

Joseph G. Beard is the new president of the **Midwest Stoker Association**, Chicago organization of wholesalers and distributors of mechanical coal stokers. Mr. Beard, assistant manager of the Freeman Stoker Division, Illinois Iron & Bolt Co., was elected at the recent annual meeting of the organization, and succeeds John J. Hayes. Other officers elected were: vice-president, **F. J. Moran**; and secretary-treasurer, **E. W. Jones**.

Buffalo Bolt Co. of North Tonawanda, N. Y., manufacturers of bolts, nuts and rivets, announces the incorporation of **Buffalo International Corp.** with **J. C. Walker** as president. A wholly owned subsidiary, the Buffalo International Corporation will handle all overseas selling for the parent company and manufacturing subsidiaries.

The Westinghouse Electric Corp. has announced the election of **Gwilym A. Price** as president, succeeding **George H. Bucher**, who has resigned from that office. Under a recent amendment of the corporation's bylaws, Mr. Price as president will be the chief executive officer. **A. W. Robertson**, who as chairman has been the corporation's chief executive officer since 1929, has reached retirement age. He was elected chairman of the Westinghouse board of directors under the new bylaws and will continue as a member of the Westinghouse organization in a less active capacity. Mr. Bucher was elected vice chairman of the Board of Directors and will continue to serve as chairman of the Westinghouse Electric International Company, which handles all export business of the parent Company, and will have other active duties.

G. A. Price

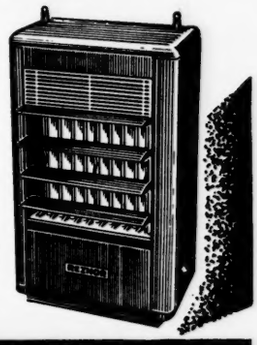
Research Products Corp., Madison, Wis., manufacturers of air filters, expanded fiber products, and water treating minerals, has announced the recent appointment of **Albert W. Brown** to its sales staff. Recently discharged from the Army, Mr. Brown will aid Research Products dealers in their local sales promotion campaigns.

"Yes. Heat where you want it—"

REZNOR

Gas unit heaters

1. Will heat ANY size area.
2. Economical way to extend inadequate heating systems.
3. Easy, low-cost installation.
4. Clean, automatic heat.
5. Suspended, saves floor space.
6. Ideal for modernizing industrial and commercial buildings.



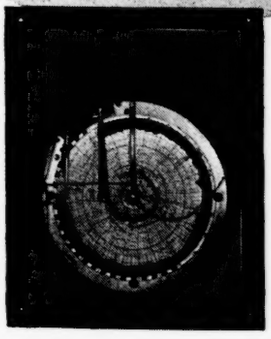
★

Propeller fan and blower types. Nine sizes of each.

REZNOR MANUFACTURING CO.
Since 1888
MERCER, PENNA.

NO BOILERS • NO STEAM LINES
NO FUEL STORAGE • NO FIRE TENDING

It's Infallible! . . .



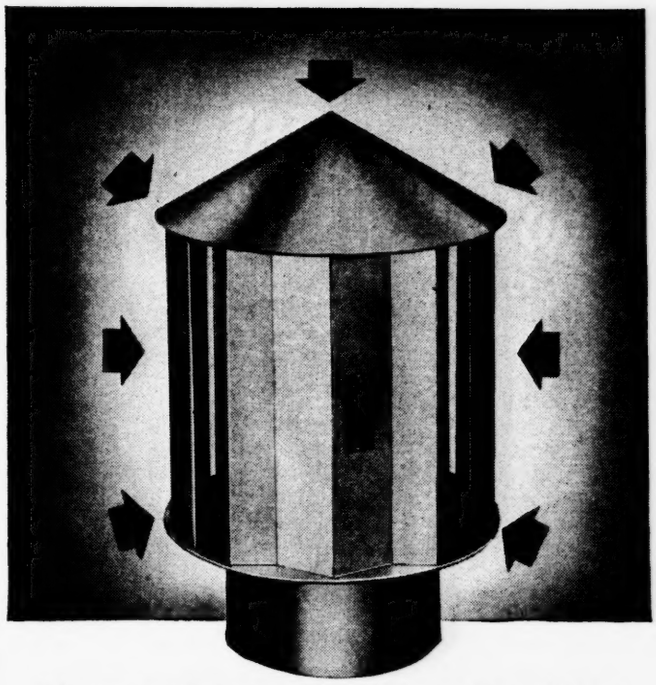
HAYS CO_2 Recorder

Knowing the CO_2 content in the flues is the simple, quick, *best* measure of combustion efficiency—and Hays CO_2 Recorder has no superior for reliable accuracy. It is built to last—no moving parts, nothing to wear out; and is the accepted standard among experienced combustion engineers.

For the facts — readable, exceedingly worth getting

. . . Send for Bulletin 45-452

The HAYS CORPORATION
SINCE 1901 COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.



Safe, sure ventilation no matter which way the wind blows!

ONLY THE BREIDERT CAN PROVE IT!

Designed on scientifically sound but revolutionary principles, the Breidert Air-X-Hauster uses aerodynamics to achieve new standards of ventilating efficiency. The Breidert was the *first* ventilator to claim that it provides safe, sure ventilation no matter which way the wind blows. *It is the only ventilator to date to prove it!*

Tests made and certified by recognized commercial testing laboratories (Smith, Emery & Co.) with wind directed at all angles against the Breidert, have conclusively proved its high capacities under all wind conditions. Even though the Breidert's capacity ratings are based on the *average of all directional tests,* it outperforms every recognized make of ventilator! It has no moving parts and cannot "backdraft" where no interior negative pressure exists.

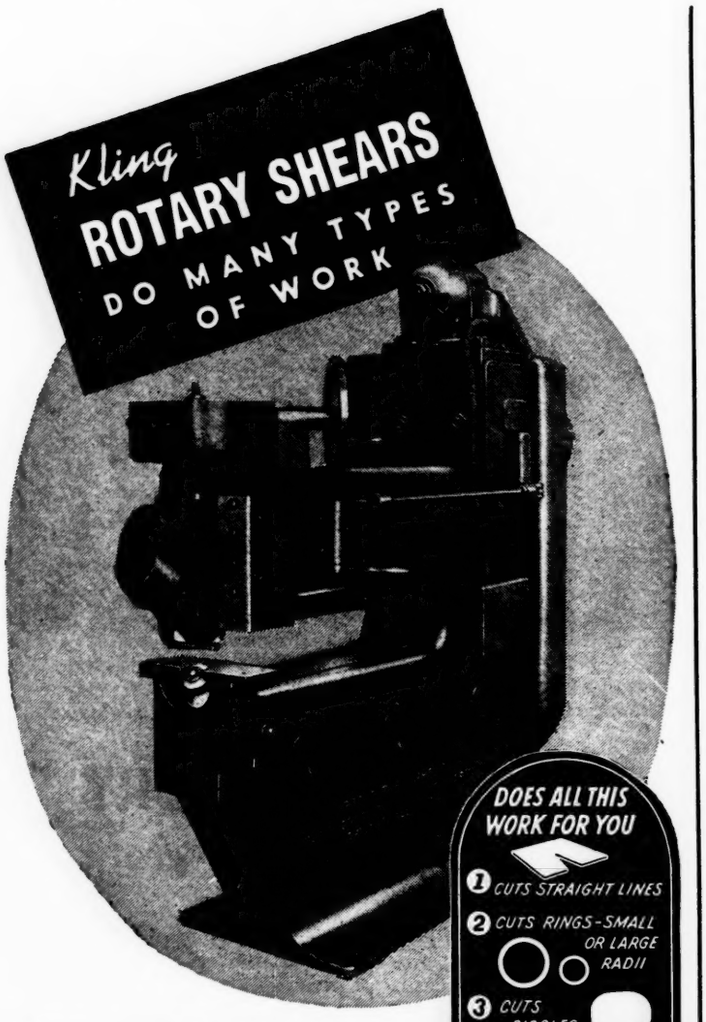
Other ventilators may look like the Breidert, but they cannot perform like it. The design of the Breidert Air-X-Hauster is based on several Breidert ventilator patents, each representing a step forward in ventilator designing over a period of many years. Over 100,000 Breidert ventilators have been used on Pullman and other railway cars, and thousands of Breidert Air-X-Hauster roof ventilators, vent flue caps, chimney tops, and marine ventilators are now successfully used on homes, buildings, and ships of all kinds.

For full details about the Breidert Air-X-Hauster, including complete engineering data, capacity ratings, specifications, etc., address Dept. R.

Breidert Air-X-Hausters
PAT. NO. 2269428

G. C. BREIDERT CO.

634 South Spring St., Los Angeles 14, Calif.
REPRESENTATIVES LOCATED IN PRINCIPAL CITIES OF THE U. S.



Yes, and With Hairline Precision

Rapid operation . . . Hairline Accuracy . . . the use of Kling Rotary Shears marks the latest development in cutting mild steel, and sheet metal, up to 1-inch with amazing savings in time, labor, and production costs.

For exacting projects (see illustration at the right), no single unit of metal-working equipment does so many different things so cleanly and efficiently as does the Kling Rotary, pictured above.

In metal working plants, automotive, aviation, home appliance, and other industries, where work of this character is being done, — this machine is held in high regard for its versatility and economy of operation.

This great usefulness is the result of half-a-hundred years of engineering experience which prospective buyers, with reason and respect, applaud.

DOES ALL THIS WORK FOR YOU

1. CUTS STRAIGHT LINES
2. CUTS RINGS-SMALL OR LARGE RADII
3. CUTS CIRCLES
4. MAKES FLANGES
5. CUTS INSIDE HOLES WITHOUT CUTTING IN FROM EDGES
6. JOGGLES & OFFSETS
7. CUTS ODD SHAPES
8. BEVELS OF ANY ANGLE
9. CUTS REVERSE CURVES
10. BEADS & U'S

ALL WITH *Hairline* PRECISION

Send Today for Bulletin No. 245 which will give you specific facts, and specifications. No obligation involved. Users of heavy equipment of Kling Rotary Shears' class will receive a copy of this Bulletin promptly, on request.

KLING BROS. *Engineering Works*

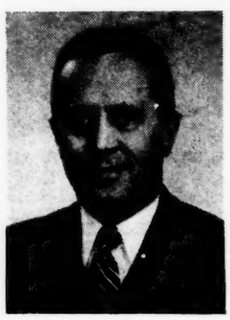
1304-HV No. Kostner Ave., Chicago 51, Illinois

EXPORT DEPT. 1111 South Ferry Building, New York 4, N. Y.

Kenneth R. Knapp has been appointed assistant director of the **American Gas Association Testing Laboratories** in Cleveland and Los Angeles, H. Carl Wolf, managing director of the association announced today. **He will serve** as assistant to R. M. Conner, Director of the A. G. A. Testing Laboratories, in supervising the testing and research activities conducted by two laboratories of the gas industry's trade association.

Frank R. Zumbro, chief engineer of the ice and refrigerating machinery department of **Frick Co.**, Waynesboro, Penn., died suddenly of coronary occlusion, at his home, on February 17. He was one of the most widely known engineers in the refrigerating industry. Mr. Zumbro was born at Mercersburg, Pa., March 22, 1890. Early in 1920 he joined the engineering staff of Frick Company, and 15 years later was made chief engineer. He was a past director of the American Society of Refrigerating Engineers, and served on many of its committees: he was also chairman of the engineering committee of the Air Conditioning and Refrigerating Machinery Association.

Jack Green has been appointed sales manager of the welding fittings division, **Tube Turns, Inc.**, Louisville, Ky. He joined Tube Turns in February, 1941. He was stationed in Chicago, as district manager, before becoming the division's assistant sales manager in June, 1943. Succeeding Jack Green as assistant sales manager of the welding fittings division is **Tom Pike.** Born in Coalinga, Calif., he graduated from U.C.L.A. and is a specialist in refinery and oil well equipment. He was placed in charge of the Los Angeles office in January, 1940. He subsequently became district manager in charge of the West Coast territory.



Jack Green

Tom Pike

Twenty-four sales and 11 service engineers have been added by the **Brown Instrument Co.** and have been assigned to branch offices of **Minneapolis-Honeywell Regulator Co.** of which the Brown company is the industrial division.

The sales engineers and the offices to which each has been assigned are as follows: D. L. Russell, Boston; A. F. Cecere, Hartford, Conn.; J. A. Rorex, Houston, Tex.; R. Mitchell, A. D. Mayo, Jr., and H. W. Greisback, Chicago; C. C. Spousta, Jr., and A. R. Willy, Indianapolis; D. F. DeVine, Portland, Ore.; W. H. Palmer and Ross Hubley, Minneapolis; J. Dunlap, Toledo; H. W. Araucz, Detroit; A. T. Challman, San Francisco; H. T. Noonan, Buffalo; L. T. Macgill and A. M. Zellar, Philadelphia; C. McIntire, Cincinnati; R. D. Bailey, Washington, D. C.; J. F. Stein, St. Louis; H. W. Sinewe, Pittsburgh; R. A. Wolfe and E. G. Brown, New York City, and R. F. Bruckart, Cleveland.

The service engineers added to the staff and the cities to which they have been assigned are: G. F. Neill and C. Vivion, Atlanta, Ga.; W. W. Weaver, Boston; J. J. Asklar, Hartford, Conn.; C. Hornbacker and J. P. Chuchman, Chicago; M. T. Glass, Dallas; A. T. Nicholls, Buffalo; A. Bernard, Montreal, Can.; O. P. Kelly, Syracuse, N. Y., and H. E. Luther, Indianapolis.

PEERLESS PUMPS

UPON THE STRONG, GREATER STRENGTH IS BESTOWED

A Statement by FOOD MACHINERY CORPORATION in regard to *Dayton-Dowd*

An important advance in the history of the pumping industry now for the first time makes available a new conception of integrated pump service to customers. *Dayton-Dowd,* long associated with sustained high quality—a distinguished name on centrifugal pumps—has become an integral part of the *Peerless Pump* organization.

This merger of broad installation-wise experience, modern technical research and alert engineering talent assures our customers for both Horizontal and Vertical types of pumps that the name "Peerless" stands as the guarantee for quality and progress.

PEERLESS HORIZONTAL PUMPS
-formerly Dayton-Dowd

F.M.C. builds with STEEL

PEERLESS PUMP DIV.—FOOD MACHINERY CORP.
Factories: Los Angeles, Calif., Quincy, Ill., Canton, O.

WAR-TIME BUILDERS OF THE VICTORIOUS "WATER BUFFALO"
PEACE-TIME BUILDERS OF TOP-FLIGHT WATER PUMPS

No. 1 Man *in* COOLING TOWERS

A specialist to serve you

Marley application engineers, in all principal cities, are experts in water cooling problems. They are backed by Marley's quarter-century of specialized experience in the production of water cooling equipment. Without charge, The Marley Co., Inc., Kansas City, Kansas, will arrange immediate consultation with an Application Engineer.

THE MARLEY CO., INC. • KANSAS CITY 15, KANSAS

STICKS to the job

B-H NO. 1 INSULATING CEMENT

B-H No. 1 Cement sticks *instantly*—on any surface. It won't slide off or roll up behind the trowel. It won't drop from under-surfaces. An unskilled laborer can apply it quickly and neatly, without trouble or waste.

Low in calcium, high in silica, it does not disintegrate. Containing a special rust-inhibitor, it safeguards metal from corrosion and assures a permanent bond. It *sticks* to the job!

B-H No. 1 Cement brings you many other advantages. Because its basis is *black* Rockwool—it has high resistance to both heat and moisture. It withstands temperatures up to 1800° F.

B-H No. 1 Cement can be stocked without breakage or loss and is reclaimable up to 1200° F. Thus it is in every way *practical* for maintenance work—especially for valves, fittings and irregular surfaces, large or small, and as a finish over blanket and block insulations.

JOBBERS are preparing to supply this easily-applied, cost-reducing product. It will pay you to investigate. Baldwin-Hill Co., 561 Klagg Avenue, Trenton 2, N. J.

Baldwin-Hill

BH

SPECIALISTS IN
THERMAL INSULATION PRODUCTS

It takes Genuine Wagner Parts to retain the high quality of Wagner MOTORS

Wagner Motor Parts ARE AVAILABLE at 325 authorized service stations displaying this sign ▸▸

Wagner designs and builds each motor part to assure dependable service for which Wagner motors are world-famous. When it's a Wagner motor, be sure to put in genuine Wagner motor parts.

Dependable switches with silver contacts.

Correct-grade brushes assure new motor performance.

Rigid, lightweight, one-piece brush-holder assemblies have carefully selected springs to assure proper contact between brushes and commutator.

Commutator originally designed as an inherent part of the motor.

Nonhardening wicks of pure wool which actually filter the oil.

Full-finished bimetal bearings ready to install. May be had *unbored* for undersized shafts.

M46-8B

Ask for Catalog MU-40.

Every repair shop needs one. It helps you determine the catalog number and price of Wagner motor parts.

Wagner WE Electric

6463 Plymouth Ave., St. Louis 14, Mo.

At the 29th annual meeting of the **National Association of Fan Manufacturers** held at Hot Springs, January 24-25 the following officers were elected for the ensuing year: G. C. Derry, president; R. H. Nelson, vice-president; and L. O. Monroe, Secretary-Treasurer. Mr. Derry is vice-president and general manager of the B. F. Sturtevant Company, Boston, Mass. and Mr. Nelson is President of The Herman Nelson Corp., Moline, Ill.

The Chicago Production Show, sponsored by the **Chicago Technical Societies Council, will be held in the Exhibition Hall of the Stevens Hotel, Chicago, March 20, 21 and 22,** concurrently with the council's annual conference. Emphasis will be on new advances in all departments of industrial production, tools, materials, instruments, and miscellaneous equipment. Showing wide diversity, more than 100 firms and 47 societies will be represented.

Wagner Electric Corp. announces changes in factory management personnel. **G. B. Evans,** general superintendent since 1921, has been promoted to plant manager. Mr. Evans has been with the Wagner Company for 41 years, having begun his career at Wagner in 1904 as a tool and die maker at the original Wagner plant. In 1914 he was made divisional superintendent. In 1921 he was promoted to general superintendent, the position he held until being made plant manager.

C. W. Hesse succeeds Mr. Evans as general superintendent. Mr. Hesse was plant engineer of Wagner Electric for 15 years, from 1927 until 1942, at which time he became assistant general superintendent, the position he held until his recent promotion to General Superintendent. Mr. Hesse has headed several departments since starting with the company in 1919, immediately after his discharge from the Army Air Service.

W. A. Okenfuss has been promoted to assistant general superintendent. He began his employment with the Wagner Company in 1919 as an inspector in the ignition department. He handled a number of jobs throughout the shop before transferring to the time study department in 1922. He was promoted to the head of time study and operating department in 1927.

The advantages of heating by means of radiant baseboards were described by three speakers at a meeting of the **Illinois Chapter of the American Society of Heating and Ventilating Engineers** at the Merchants & Manufacturers Club in Chicago.

Speakers were Warren S. Harris, research professor, University of Illinois; John P. Magos, director of research, Crane Co.; and M. W. McRae, research engineer, Crane Co. More than 300 heating and ventilating engineers, contractors, architects, and manufacturers attended the meeting. Questions from the floor after the formal talks indicated active interest in radiant baseboards.

A new Canadian company — **Penn Controls, Ltd.** — has been formed to manufacture and sell Penn automatic controls for heating, refrigeration, pump and air compressor applications as well as safety controls for engines, according to Albert Penn, president of **Penn Electric Switch Co.** of Goshen, Ind. The factory and sales office of Penn Controls, Ltd. are located at 284 King St., W., Toronto 2B, Canada.

T. M. Dailey, Philadelphia, Pa., was named field representative for **Harvey-Whipple, Inc.,** manufacturers of Master Kraft oil heating equipment, to cover eastern Pennsylvania, Maryland, Delaware, and District of Columbia.

At the 20th annual meeting of the **Industrial Unit Heater Association** held at the Roosevelt Hotel, New York, N. Y., January 31, the following officers were elected for the ensuing year: R. Resch, president; F. P. Kohlbry, vice-president; L. O. Monroe, secretary-treasurer.

Mr. Resch is president of McQuay, Incorporated, Minneapolis, Minnesota, and Mr. Kohlbry is president of the Airtherm Manufacturing Company, St. Louis, Missouri.

Walter Klie died at the age of 64, February 12th, 1946, at the Cleveland Clinic Hospital following an operation. Mr. Klie was president-treasurer of the Smith & Oby Co. of Cleveland, doing heating, air conditioning and plumbing in that section of the country. He had been chief executive of the company since 1914. He served as a member of the board of directors of the Heating, Piping and Air Conditioning Contractors National Association for ten years, being first elected in 1924. He was vice-president one year and president for three years, having been elected to that office in 1928, 1929 and 1930. He is one of two men who held the office of president for three terms. In addition to this service as a director and officer of the association Mr. Klie was active in committee work.

Mr. Klie was born in Columbus, Ohio, where he was educated. In 1903 he received his degree in mechanical engineering from Ohio State University.

He began his long career in industry with the Westinghouse Electric & Manufacturing Co. in 1904, and for the next two years was engaged in his own business—the Klie Heating & Plumbing Co. In 1914 he came to Cleveland as president of the Smith & Oby Co.

INDUSTRIAL DEGREE-DAYS

January, 1946

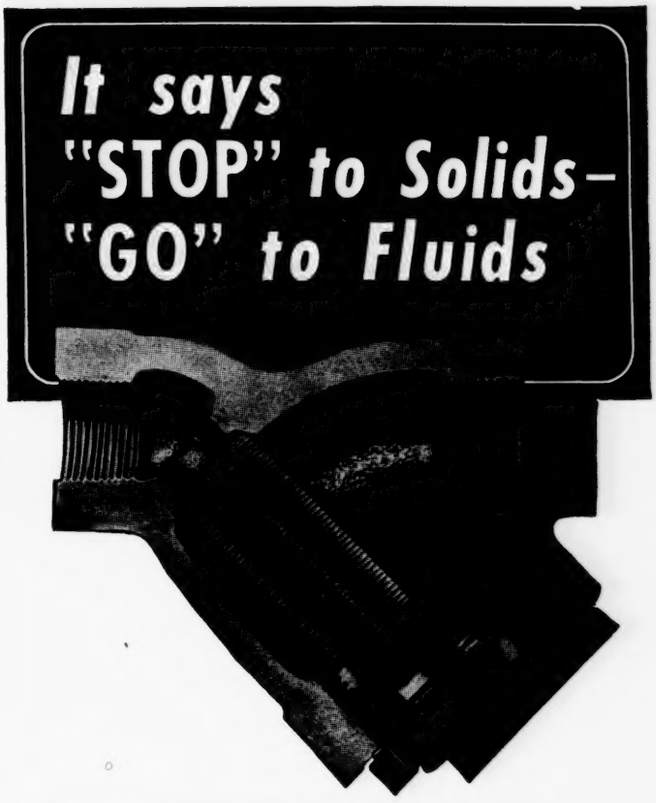
City	55F Base	45F Base
Baltimore, Md.	555	280
Buffalo, N. Y.	856	558
Chicago, Ill.	827	524
Cleveland, Ohio	804	515
Detroit, Mich.	831	534
Indianapolis, Ind.	742	454
New York, N. Y.	657	370
Philadelphia, Pa.	625	343
Pittsburgh, Pa.	661	387
St. Louis, Mo.	627	338

CANADIAN DEGREE-DAYS FOR JANUARY, 1946

City	January 1946	January Normal	Cumulative, Sept. 1 to Jan. 31 1945-46	Cumulative, Sept. 1 to Jan. 31 Normal
Calgary, Alta.	1333	1609	5525	5311
Charlottetown, P. E. I.	1457	1463	4294	4631
Crescent Valley, B. C.	1200	1352	4367	4631
Edmonton, Alta.	1327	1814	5972	5771
Fort William, Ont.	1761	1807	5866	5622
Grand Prairie, Alta.	1671	1841	6538	6000
Halifax, N. S.	1262	1283	3865	3898
London, Ont.	1296	1336	4232	4013
Medicine Hat, Alta.	1442	1643	5392	5032
Moncton, N. B.	1513	1528	4695	4714
Montreal, P. Q.	1572	1587	5847	4683
North Bay, Ont.	1705	1658	5535	5161
Ottawa, Ont.	1634	1646	4971	4923
Penticton, B. C.	1035	1184	3730	3810
Porquis Junction, Ont.	1910	2052	6389	6300
Prince George, B. C.	1329	1615	5337	5372
Quebec City, P. Q.	1637	1696	5027	5207
Regina, Sask.	1857	2037	6545	6373
St. John, N. B.	1401	1417	4348	4386
Saskatoon, Sask.	1887	2027	6628	6276
Toronto, Ont.	1208	1304	3900	3948
Vancouver, B. C.	781	893	3067	3061
Victoria, B. C.	716	815	2769	2725
Windsor, Ont.	1184	1283	3784	3729
Winnipeg, Man.	1975	2111	6422	6316

*These data are supplied through the courtesy of the Meteorological Division, Air Services Branch, Department of Transport, Canada, with the cooperation of N. W. Etter, Heating Engineer, Enamel & Heating Products Limited, Sackville, N. B.

The Department reports some slight revisions in the figures for December, as published in last month's issue. Corrected figures are: Halifax, N. S., 2587; Edmonton, Alta., 4645.



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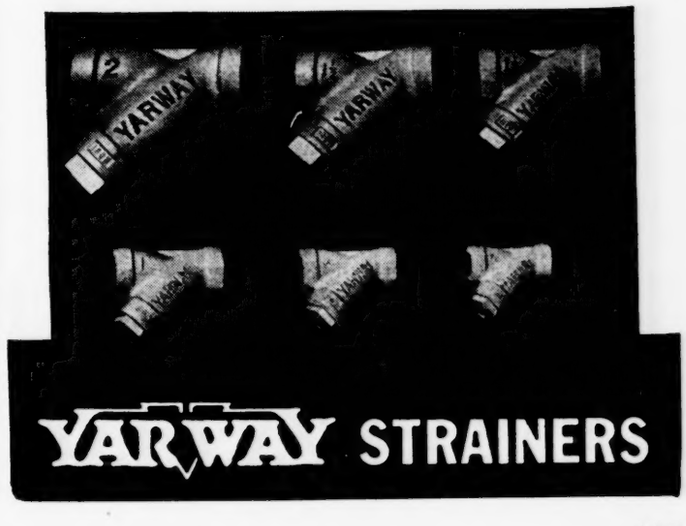
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